THE FUTURE IS IN THE SKIES

M.Kemal ATATÜRK
Founder of Turkish Republic

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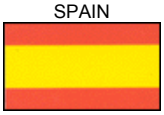
KAZAKHSTAN 	SPAIN 
TURKIYE 	USA 

CONTENTS

OPENING SPEECH OF THE HONORARY CHAIR

Distinguished Guests, Ladies and Gentlemen,

I am pleased to be opening the Internatıonal Workshop On Unmanned Vehicles, which is organized by the Aeronautics and Space Technologies Institute, or ASTIN, of the Turkish Air Force Academy.

ASTIN holds a space related technical meeting every year, a general purpose RAST Conference in odd numbered years and a workshop or two in even years. The theme of this year's workshop is Unmanned vehicles. This workshop intends to bring under one forum a discussion of the developments in the area of unmanned vehicles, in whichever medium they operate.

We at the Turkish Air Force Academy would be interested primarily with unmanned aerial vehicles or UAVs, which are the most widely known of such vehicles. In fact UAVs, have undergone extensive development and deployment, to the point where they are in the process of being integrated into the air traffic system along with piloted aircraft. However when we were discussing the subject matter of this workshop, we noted that research and development work, regarding all kinds of unmanned vehicles whether in the air, on land, sea, or under water, is actively continuing in industry and academia. I should also add satellites to that list as they are unmanned space vehicles. We also noted that regardless of the medium of operation, there is a certain underlying knowledge base including theory and technology, which is common to all, including such areas as robotics, sensors, intelligent systems, and computational power. While each medium of operation has its own characteristics which dictate upon the vehicle, researchers in unmanned vehicles have a lot in common to share. So we have deemed it most appropriate and beneficial to hold this workshop to cover all areas of unmanned vehicles.

We at ASTIN have 5 departments which are all in areas of engineering: These are electronics enginering, industrial engineering, aeronautical engineering, computer engineering and space technology. I am happy to see that all our students at ASTIN attending this workshop, will get exposed to the developments both in aerial umanned vehicles and the concepts for general autonomous vehicle steering, involving sensing, modeling and much intelligent work on the part of machines. I am sure thjey will eagerly listen and at times contribute to the discussions, as they hear prominent speakers in their fields as well as other scientists and engineers doing valuable research and development work.

It is our desire to provide our students with a wide multi disciplinary look into their professional fields, including not just engineering, but also basic sciences, market trends and naturally defense eqirement.

Ladies and gentlemen,

I welcome you all to the Workshop. I thank all the people who have worked hard to put together a succeful meeting, especially to our invited guests for taking their time to contribute to our meeting. I wish you a fruitful meeting and a memorable time.

İsmail TAŞ
Major General
Commander, TuAF Academy

FOREWORD

Commander, Distinguished Guests, Dear Collegues, Ladies and Gentlemen,

I am honored and pleased to be welcoming you to this Workshop on Unmanned Vehicles. This is the workshop we at ASTIN are holding this year in our series of workshops which are held in even numbered years. You may know that in odd numbered years we hold our traditional International Conference on Recent Advances in Space Technologies or RAST conferences.

For this year's workshop we chose to focus on unmanned vehicles. We all know that a subset of that class is very relevant to the TurkishAir Force as well as most other air forces. And that is aerial unmanned vehicles or UAVs. In our discussions however we have decided that a wider perspective on unmanned vehicles of all sorts would be a better choice for the topic of the workshıp. This is because of the common theoretical and design aspects of the different unmanned vehicles regardless of their type. At the same time we are aware that each unmanned vehicle has different requirements due to, not only its medium of operation but also its particular mission.

Applications of unmanned vehicles have been proliferating, in all mediums from air to ground and marine applications including underwater. Furthermore they appear not just in the world of defense but also in civil and commercial areas.

In organizing the workshop it has been our goal to bring together representatives from academia, industry and government, working on different types of unmanned vehicles, and different aspects of theory, design, development and deployment. We believe we have achieved our objective to a satisfactory extent in that respect. I also hope and expect a good interaction between the user community, and the research and development community during the workshop.

I am happy that a number of distinguished names are with us today as invited speakers. I am sure we will listen to them with interest to hear about the latest trends in the world of unmanned vehicles. We thank them very much.

At ASTIN as always, we try to keep our contacts with the relevant academic and research community in Turkey and around the world as much as we can. We consider these workshops a very important and integral part of the education at ASTIN.

I am happy to be witnessing the start of another such important event. I welcome you all and I wish that you have a very fruitful workshop and a good time.

Sefer KURNAZ
Colonel
Director of ASTIN

WORKSHOP COMMITEES

Organized by: Aeronautics and Space Technologies Institute (ASTIN), Turkish Air Force Academy, Türkiye İstanbul Technical University, Türkiye Boğaziçi University, Türkiye Bahçeşehir University, Türkiye Yıldız Technical University, Türkiye İstanbul Commerce University, Türkiye Yeditepe University, Türkiye Okan University, Türkiye	**Honorary Chair:** Major General İsmail Taş (Commander, TuAF Academy) **General Chair:** Col. Sefer Kurnaz (ASTIN)
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PROGRAM AT A GLANCE

UVW2010 WORKSHOP PROGRAM

TIME	10 JUNE 2010 THURSDAY	11JUNE 2010 FRIDAY	12JUNE 2010 SATURDAY
08:00	REGISTRATION	FREE	FREE
09:00		Chair: Prof.Dr. Adil Yükselen	Chair: Prof.Dr. Hakan Temeltaş
09:15	OPENING CEREMONY	KEYNOTE SPEECHES (PLENARY-3) Prof.Dr. Alberto Broggi, Prof.Dr. Rustam Rustamov, Prof.Dr. Arsev Eraslan	
	Chair: Prof. Dr. Fuat İnce		SESSION-6
	KEYNOTE SPEECHES (PLENARY-1) Prof.Dr.Ümit Özgüner (OSU)		(İnönü Hall)
10:00		(İnönü Hall)	PAPER ID:30,38,45,46,47,48,50
10:30	PERFORMANCE BY HISTORIC JANISSARY BAND		
11:00	COFFEE BREAK	COFFEE BREAK	COFFEE BREAK
	Chair:Prof. Dr. Fuat İnce	Chair: Prof Dr. Derya Maktav	Chair: Prof.Dr. Tayfun Günel
	plenary-2 Prof.Dr. Chuck Thorpe, Prof.Dr. Robert Michelson (30 Ağustos Zafer Hall)	SESSION-3 (İnönü Hall) PAPER ID: 2,4,6,22,26,34,61	SESSION-7 (İnönü Hall) PAPER ID:3,39,54,67
12:30			
14:00	LUNCH (TURKISH OFFICERS' CLUB)	LUNCH (TURKISH OFFICERS' CLUB)	LUNCH (TURKISH OFFICERS' CLUB)
	Chair: Prof. Dr.Seyhan Onbaşioğlu	Chair: Prof.Dr. M.Fevzi Ünal	
	SESSION 1 (İnönü Hall) PAPER ID: 35,36,53,56,60,64,66	SESSION 4 (İnönü Hall) PAPER ID: 49,51,52,55,63,65,69	POSTER SESSION POSTER AREA 11JUNE 2010 FRIDAY 14:00-18:00 PAPER ID:1,7,13,27,32,42,43
15:30			
16:00	COFFEE BREAK	COFFEE BREAK	
	Chair: Prof.Dr. Şenay Yalçın	Chair: Prof Dr. Okya Kaynak	
	SESSION 2 (İnönü Hall) PAPER ID: 5,10,12,17,25,41,62	SESSION 5 (İnönü Hall) PAPER ID: 15,16,18,20,21,23,28	
17:30			
	FREE	FREE	
	WELCOME COCKTAIL(19:00)	WORKSHOP DINNER 20:00	

OPENING SESSION
10 JUNE 2010 THURSDAY
09.00-10.30

Chair : Prof Dr.Fuat İnce **Room:** 30 Ağustos Zafer Hall

Time	Program
09.00-09.05	National Anthem
09.05-09.10	Welcoming Speech of Major General İsmail TAŞ (Commander, TuAF Academy)
09.10-09.15	Speech of the General Chair, Col. Sefer KURNAZ (ASTIN, TuAF)
09.15-10.00	Plenary Session-1
10.00-10.30	Performance by Historic Janissary Band
10.30-11.00	Coffee Break

PLENARY SESSIONS
10 JUNE 2010 THURSDAY
09.15-10.00

Plenary-1: Keynote Speech
Chair : Prof Dr.Fuat İnce **Room:** 30 Ağustos Zafer Hall

No	Name/Surname	Affiliation	Title of Speech
1	Prof.Dr. Ümit Özgüner	TRC Inc. Chair on ITS OSU Dept. of ECE 2015 Neil Ave., Columbus OH 43210	Developments in Unmanned Ground Vehicles

10 JUNE 2010 THURSDAY
11:00-12:30

Plenary-2: Keynote Speeches
Chair : Prof Dr.Fuat İnce **Room:** 30 Ağustos Zafer Hall

No	Name/Surname	Affiliation	Title of Speech
1	Prof.Dr. Chuck Thorpe	Dean Carnegie Mellon University in Qatar	Navigation on the Carnegie Mellon Navlab: Integrating GPS with SLAM
2	Prof .Dr. Robert C. Michelson	Principal Research Engineer, Emeritus Georgia Tech Research Institute	Slow Flight in the Lower Mars Atmosphere in Support of NASA Science Missions

11 JUNE 2010 FRIDAY

09.00-10.30

Plenary-3: Keynote Speeches

Chair : Prof Dr.Seyhan Onbaşıoğlu **Room:** İnönü Hall

No	Name/Surname	Affiliation	Title of Speech
1	Prof.Dr. Alberto Broggi	VisLab, The Artificial Vision and Intelligent Systems Lab. Universitiy of Parma	An Extensive Unmanned Driving Test in Real Conditions
2	Prof.Dr. Rustam Rustamov	Institute of Physics of the Azerbaijan National Academy of Sciences	Development and Applications of the Unmanned Vehicles
3	Prof .Dr.Arsev Eraslan	Bogaziçi University and ASTIN	Modern UAV Design and Operation From Aerodynamics Modeling to Digital Flight Control

SESSIONS

10 JUNE 2010 THURSDAY

14.00-15.30

Session 1

Chair : Prof Dr. Adil Yükselen **Room :** İnönü Hall

No	Title	Author(s)
1	Optimization with Elitist Genetic Algorithm Method in Prelıminary Design of Unmanned Air Vehicle & its Propulsion System	Ali Dinç, Hidayet Buğdaycı, Oğuz Uzol
2	The Challenges Awaiting Governments Over the UAV Quest	Yaşar Gürbüz ÖZEN, Gökhan Şükrü EFE
3	Obstacle Avoıdance For Formatıon Of Unmanned Vehıcles	Mehmet Eren Erdoğan, Mario Innocenti
4	Autopilot Failures during Operation of the Unmanned Complex	Dimitar Jordanov, Svetlin Fotev
5	Design and Manufacture of a Fuel Cell Powered Unmanned Air Vehicle	Unver Kaynak, Rauf Akbaba, Alptekin Kibar Coşku Kasnakoğlu, Nilay Sezer-Uzol, Emre Güleç, Semih Tekelioğlu, Mehmet Burak Solmaz
6	Onboard Aircraft Engine FDI via Stochastic Nonlinear Modeling of Flight Variable Interrelations	D. Dimogianopoulos, J. Hios, S.D. Fassois

7	Design Process of Cevheri-3	Hasan ÇAKIR, Emre ÖZBEK, M.Burak ÖZBİLGİN, Onur ÜNLÜ, Serkan AKGÜL, Mansur ÇELEBİ, Zafer KAZANCI, Abdurrahman HACIOĞLU

10 JUNE 2010 THURSDAY

16.00-17.30

Session 2

Chair : Prof Dr. Şenay Yalçın **Room :** İnönü Hall

No	Title	Author(s)
1	Morphing Air Vehicle Concepts	Prof. Dr. Serkan ÖZGEN, Prof. Dr. Yavuz YAMAN, Asst. Prof. Dr. Melin Şahin, Asst. Prof. Dr. Güçlü Seber, Sinan KÖRPE, Evren SAKARYA, Levent ÜNLÜSOY, Tolga İNSUYU, Assoc. Prof. Dr. Göknur BAYRAM, Assoc. Prof. Dr. Yusuf ULUDAĞ, Assoc. Prof. Dr. Ayşen YILMAZ
2	Design, Analysis and Experimental Modal Testing of a Mission Adaptive Wing of an Unmanned Aerial Vehicle	Melin Şahin , Yavuz Yaman, Serkan Özgen, Güçlü Seber, Evren Sakarya, Levent Ünlüsoy, E. Tolga İnsuyu
3	An Adaptive Sensor Fusion Method Applied to UAV Dynamics	Halil Ersin Soken, Chingiz Hajiyev
4	3-D Linear Kalman Filter Tracking Unmanned Aerial Vehicle	Andon D. Lazarov
5	Monitoring the Health of Unmanned Aerial Vehicles	Ibrahim N. Tansel, Ming Li, Gurjiwan Singh, Gurjashan Singh, Srikanth Korla
6	An analysis of the perturbing factors in the spacecraft motion simulation model	Alipbayev K., Rakisheva Z., Sukhenko A., Ahmedov D.
7	Slow flight in the lower Mars Atmosphere in support of NASA science missions	Robert C. Michelson

11 JUNE 2010 FRIDAY

11.00-12.30

Session 3

Chair : Prof Dr. Derya Maktav **Room :** İnönü Hall

No	Title	Author(s)
1	QB50 Mission: A pioneering project for the future networks of unmanned vehicles	Cem Ozan Asma, Ruedeger Reinhard
2	Automatic 3D Reconstruction of Underwater Scenes from Uncalibrated Video Sequences	İlkay Ulusoy, Yavuz Kırlı
3	Development of Mini Scale Autonomous Robot Grader for Road Constructions	Önder Halis Bettemir
4	Development of Autonomous Underwater Vehicle (AUV) Navigation System Based on Kalman Filtering Technique	Mustafa Dinç, Chingiz Hajiyev
5	A Systematic Design and Integration Approach for the Development of an Unmanned Underwater Vehicle	Tuğrul ADIGÜZEL, Ahmet AKBULUT, A. Egemen YILMAZ, Özgür YILDIZ Bülent GÖKALP
6	Hydrogliding – a Fuel-Efficient Mode for Underwater AUV Ppopulsion	Deniz Ünsalan, Kunsel İZET-ÜNSALAN, Stelian GALETUSE
7	Development of a Steered Unmanned Ground Electric Vehicle Research Platform	Gökhan Bayar, A. Bugra Koku, E. ilhan Konukseven

11 JUNE 2010 FRIDAY

14.00-15.30

Session 4

Chair : Prof Dr. M.Fevzi Ünal **Room :** İnönü Hall

No	Title	Author(s)
1	Structural Desıgn of a Quadrotor	Çağrı ÇIKRIKÇI, Erol ER,A.Görkem ARISOY,H.Görkem ÖZKAN, Evren ÖZŞAHİN,Halit S. TÜRKMEN
2	An Intelligent PID Tuning Method for an Autonomous Mobile Robot	Alpaslan Yufka, Ahmet Yazıcı
3	Cooperative Transportation by Multiple Autonomous Non-holonomic Mobile Robots	Alpaslan Yufka, Metin Özkan
4	Unmanned Systems Endowed with Attention	Özgür Erkent, Işıl Bozma
5	A Family of Unmanned Rotorcraft Systems for Versatile Missions	Hasan Ibacoglu, Aytekin Guven, Taner Mutlu, Kerem Anbarci, A. Rustem Aslan H. Temel Belek
6	HILSim for Attitude Control of a Quadrotor	M.K.BAYRAKÇEKEN, M. ILARSLAN, A.ARISOY, A. KARAMANCIOĞLU
7	A Real-time SLAM Algorithm with Optical Flow based Motion Extraction for Autonomous Robot Navigation	Onur SENCAN, Mert TURANLI, Evangelos SARIYANIDI, Hakan TEMELTAS , Sefer KURNAZ, Seta BOGOSYAN

11 JUNE 2010 FRIDAY

16.00-17.30

Session 5

Chair : Prof Dr. Okyay Kaynak **Room :** İnönü Hall

No	Title	Author(s)
1	LQR Controller with Kalman Estimator Applied to UAV Longitudinal Dynamics	S.Yenal Vural, Prof. Dr. Chingiz Hajiyev
2	Collaboration among Multiple Unmanned Aircraft Systems to Search, Detect, and Locate Ground Targets	Daniel Pack, Dimitri Zarzhitsky, Hyukseong Kwon
3	Performance Analysis of Formation Flight Control over Fading Communication Channels	Adrian-Mihail Stoica, Bogdan Donciu, Stelian Găletuşe
4	A Case for the Development of Models to Capture the Dynamical Responses to UAV Surveillance and Engagement Actions	Peter J. Sherman
5	Assessment of Expertise Development and Cognitive Workload of UAV Operators in a Simulated Environment: A Functional Brain Imaging Approach	Murat Perit Çakır, Justin Menda, Hasan Ayaz, Kurtuluş İzzetoğlu, Banu Onaral
6	Development and Applications of the Unmanned Vehicles	Sefer Kurnaz, Rustam B. Rustamov
7	Phases in the Autopilot Development	Corneliu AXENTE, Sabin CODREA

12 JUNE 2010 SATURDAY

09.00-10.00

Session 6

Chair : Prof Dr. Hakan Temeltaş **Room :** İnönü Hall

No	Title	Author(s)
1	Systems Engineering in UAV Development	A.Bahar HASER, A.Erdem KAZAKLI, Seçkin ARIBAL
2	Safety Process Application in Unmanned Air Vehicle Development Programs	Sirma CELIK, Zeynep KOCABAS
3	Target Drones And Development Efforts in Turkey	Yener ÇETİN
4	Challenges in the Aerodynamic Design of A Uav	Gürkan Çetin
5	Turkish Male UAV Development Program	Remzi Barlas, Tarkan Karşıdağ,Şenol Sergen
6	Genetically Optiımized Neural Network Systems (Gonns) Applications for Unmanned Vehicles	Ibrahim N. Tansel, Gurjiwan Singh, Gurjashan Singh, Srikanth Korla, Ming Li, Balemir Uragun, Mustafa Demetgul
7	Reliability Analysis Process in UAS Development Programs	Anıl DEMİREL, Ebru Nihal ÇETİN

12 JUNE 2010 SATURDAY

11.00-12.30

Session 7

Chair : Prof Dr. Tayfun Günel **Room :** İnönü Hall

No	Title	Author(s)
1	An Automatic System to Detect Thermal Leakages on Building Facade Using Thermal Images	Dr.Beril Sırmacek
2	Investigation of Waveform Design for Range-Doppler Estimation Exploiting Cyclostationarity	Antonio Napolitano, Kutluyil Dogancay
3	Integer Linear Programming Based Mission Planning for UAVs	Ozcan Ozturk, Can U. Hantas
4	Design Process of Anatolian Eagle	Sinan METİN, Ali BAŞAR, Serhat GÖKALP, Ali KARANLIK, Serkan AKGÜL, Mansur ÇELEBİ, Zafer KAZANCI, Abdurrahman HACIOĞLU

POSTER SESSIONS

11 JUNE 2010 FRIDAY

14.00-18.00

No	Title	Author(s)
1	Optimal Path-finding Algorithm for Autonomous Unmanned Ground Vehicles	Petr Stodola, Jan Mazal
2	Structural Changes in Future Military Operations and Human Factors Concerning Manned and Unmanned Systems	Coskun Kurkcu, Haluk Erhan
3	Development of a Proton Exchange Membrane Hydrogen Fuel Cell Stack for Unmanned Underwater Vehicles	Oğuzhan KATLI, Özgür YILDIZ, İbrahim GÖKALP, Bülent GÖKALP, A. Egemen YILMAZ
4	Unmanned Aerial Vehicles Market in Aviation Industry and the Role of Integration	Ali BAŞ, Barbaros AKÇA, Erhan GAZİOĞLU, Hüseyin ERGEZEN
5	MAV Conceptual Design Challenges with Software Project Management Aspect of the MCDA Tool	Mustafa Turan, Abdülkerim Ergüner, Bayali Gezer, Ali O. Tolluoğlu
6	Hyperspectral Data Classification Using Contourlet Transform	Bedrettin Erbil Konuk, Özgür Gültekin, Işın Erer
7	Comparison of Safety Concept in Unmanned Air Platforms versus Manned Air Platforms	Alper, PAHSA Gökçen, ALAT

ABSTRACTS

ABSTRACT LIST

No	Title	Author(s)
1	Optimization with Elitist Genetic Algorithm Method in Prelıminary Design of Unmanned Air Vehicle & its Propulsion System	Ali Dinç, Hidayet Buğdaycı, Oğuz Uzol
2	The Challenges Awaiting Governments Over the UAV Quest	Yaşar Gürbüz ÖZEN, Gökhan Şükrü EFE
3	Obstacle Avoıdance For Formatıon Of Unmanned Vehıcles	Mehmet Eren Erdoğan, Mario Innocenti
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7	Design Process of Cevheri-3	Hasan ÇAKIR, Emre ÖZBEK, M.Burak ÖZBİLGİN, Onur ÜNLÜ, Serkan AKGÜL, Mansur ÇELEBİ, Zafer KAZANCI, Abdurrahman HACIOĞLU
8	Morphing Air Vehicle Concepts	Prof. Dr. Serkan ÖZGEN, Prof. Dr. Yavuz YAMAN, Asst. Prof. Dr. Melin Şahin, Asst. Prof. Dr. Güçlü Seber, Sinan KÖRPE, Evren SAKARYA, Levent ÜNLÜSOY, Tolga İNSUYU, Assoc. Prof. Dr. Göknur BAYRAM, Assoc. Prof. Dr. Yusuf ULUDAĞ, Assoc. Prof. Dr. Ayşen YILMAZ
9	Design, Analysis and Experimental Modal Testing of a Mission Adaptive Wing of an Unmanned Aerial Vehicle	Melin Şahin*, Yavuz Yaman, Serkan Özgen, Güçlü Seber, Evren Sakarya‡, Levent Ünlüsoy, E. Tolga İnsuyu
10	An Adaptive Sensor Fusion Method Applied to UAV Dynamics	Halil Ersin Soken, Chingiz Hajiyev
11	3-D Linear Kalman Filter Tracking Unmanned Aerial Vehicle	Andon D. Lazarov
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13	An analysis of the perturbing factors in the spacecraft motion simulation model	Alipbayev K., Rakisheva Z., Sukhenko A., Ahmedov D.
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15	QB50 Mission: A pioneering project for the future networks of unmanned vehicles	Cem Ozan Asma, Ruedeger Reinhard
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19	A Systematic Design and Integration Approach for the Development of an Unmanned Underwater Vehicle	Tuğrul ADIGÜZEL, Ahmet AKBULUT, A. Egemen YILMAZ, Özgür YILDIZ Bülent GÖKALP
20	Hydrogliding – a Fuel-Efficient Mode for Underwater AUV Ppopulsion	Deniz Ünsalan, Kunsel İZET-ÜNSALAN, Stelian GALETUSE
21	Development of a Steered Unmanned Ground Electric Vehicle Research Platform	Gökhan Bayar, A. Bugra Koku, E. ilhan Konukseven
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24	Cooperative Transportation by Multiple Autonomous Non-holonomic Mobile Robots	Alpaslan Yufka, Metin Özkan
25	Unmanned Systems Endowed with Attention	Özgür Erkent, Işıl Bozma
26	A Family of Unmanned Rotorcraft Systems for Versatile Missions	Hasan Ibacoglu, Aytekin Guven, Taner Mutlu, Kerem Anbarci, A. Rustem Aslan H. Temel Belek
27	HILSim for Attitude Control of a Quadrotor	M.K.BAYRAKÇEKEN, M. ILARSLAN, A.ARISOY, A. KARAMANCIOĞLU
28	A Real-time SLAM Algorithm with Optical Flow based Motion Extraction for Autonomous Robot Navigation	Onur SENCAN, Mert TURANLI, Evangelos SARIYANIDI, Hakan TEMELTAS , Sefer KURNAZ, Seta BOGOSYAN
29	LQR Controller with Kalman Estimator Applied to UAV Longitudinal Dynamics	S.Yenal Vural, Prof. Dr. Chingiz Hajiyev
30	Collaboration among Multiple Unmanned Aircraft Systems to Search, Detect, and Locate Ground Targets	Daniel Pack, Dimitri Zarzhitsky, Hyukseong Kwon
31	Performance Analysis of Formation Flight Control over Fading Communication Channels	Adrian-Mihail Stoica, Bogdan Donciu, Stelian Găletuşe

32	A Case for the Development of Models to Capture the Dynamical Responses to UAV Surveillance and Engagement Actions	Peter J. Sherman
33	Assessment of Expertise Development and Cognitive Workload of UAV Operators in a Simulated Environment: A Functional Brain Imaging Approach	Murat Perit Çakır, Justin Menda, Hasan Ayaz, Kurtuluş İzzetoğlu, Banu Onaral
34	Development and Applications of the Unmanned Vehicles	Sefer Kurnaz, Rustam B. Rustamov
35	Phases in the Autopilot Development	Corneliu AXENTE, Sabin CODREA
36	Systems Engineering in UAV Development	A.Bahar HASER, A.Erdem KAZAKLI, Seçkin ARIBAL
37	Safety Process Application in Unmanned Air Vehicle Development Programs	Sirma CELIK, Zeynep KOCABAS
38	Target Drones And Development Efforts In Turkey	Yener ÇETİN
39	Challenges In The Aerodynamıc Desıgn Of A Uav	Gürkan Çetin
40	Turkısh Male UAV Development Program	Remzi Barlas, Tarkan Karşıdağ,Şenol Sergen
41	Genetıcally Optımızed Neural Network Systems (Gonns) Applıcatıons For Unmanned Vehıcles	Ibrahim N. Tansel, Gurjiwan Singh, Gurjashan Singh, Srikanth Korla, Ming Li, Balemir Uragun, Mustafa Demetgul
42	Reliability Analysis Process in UAS Development Programs	Anıl DEMİREL, Ebru Nihal ÇETİN
43	An Automatic System to Detect Thermal Leakages on Building Facade Using Thermal Images	Dr.Beril Sırmacek
44	Investigation of Waveform Design for Range-Doppler Estimation Exploiting Cyclostationarity	Antonio Napolitano, Kutluyil Dogancay
45	Integer Linear Programming Based Mission Planning for UAVs	Ozcan Ozturk, Can U. Hantas
46	Design Process of Anatolian Eagle	Sinan METİN, Ali BAŞAR, Serhat GÖKALP, Ali KARANLIK, Serkan AKGÜL, Mansur ÇELEBİ, Zafer KAZANCI, Abdurrahman HACIOĞLU
47	Optimal Path-finding Algorithm for Autonomous Unmanned Ground Vehicles	Petr Stodola, Jan Mazal
48	Structural Changes in Future Military Operations and Human Factors Concerning Manned and Unmanned Systems	Coskun Kurkcu, Haluk Erhan

49	Development of a Proton Exchange Membrane Hydrogen Fuel Cell Stack for Unmanned Underwater Vehicles	Oğuzhan KATLI, Özgür YILDIZ, İbrahim GÖKALP, Bülent GÖKALP, A. Egemen YILMAZ
50	Unmanned Aerial Vehicles Market in Aviation Industry and the Role of Integration	Ali BAŞ, Barbaros AKÇA, Erhan GAZİOĞLU, Hüseyin ERGEZEN
51	MAV Conceptual Design Challenges with Software Project Management Aspect of the MCDA Tool	Mustafa Turan, Abdülkerim Ergüner, Bayali Gezer, Ali O. Tolluoğlu
52	Hyperspectral Data Classification Using Contourlet Transform	Bedrettin Erbil Konuk, Özgür Gültekin, Işın Erer
53	Comparison of Safety Concept in Unmanned Air Platforms versus Manned Air Platforms	Alper, PAHSA Gökçen, ALAT

Optimization with Elitist Genetic Algorithm Method in Preliminary Design of Unmanned Air Vehicle & its Propulsion System

Ali Dinç
Tusaş Engine Industries Inc.
ali.dinc@tei.com.tr
Çevreyolu No:356 P.K.162,
Eskişehir, 26003, Turkey

Hidayet Buğdaycı
Anadolu University, School of Civil Aviation,
hbugdayc@anadolu.edu.tr
Eskişehir, 26470, Turkey

Oğuz Uzol
Middle East Technical University, Aerospace Engineering Department
uzol@metu.edu.tr
Ankara, 06531, Turkey

ABSTRACT

In this paper, selection of propulsion system for an unmanned air vehicle with a given mission profile and optimization in preliminary design of aircraft & its propulsion system with the method of elitism-based genetic algorithm is done. Aircraft mission profile, particularly in aircraft design, is one of the most important design inputs. As the aircraft is sized for the requirements specification (payload to be carried, range, target cost, etc.), the parameters within mission profile such as cruising altitude and speed of aircraft affect engine type, power level, fuel quantity and therefore general dimensions and the gross weight of the aircraft. In this study, a code for sizing of an unmanned aerial vehicle (UAV) and its engine by analytical method is developed and at the same time by employing an elitist genetic algorithm, preliminary sizing of an UAV and its engine that can be used in our country for purposes such as forest, land monitoring, coastal surveillance, border control, military reconnaissance missions etc. has been made and the selected engine parameters are optimized to be able to reach the maximum loiter time.

Keywords: Unmanned Air Vehicle, Mission Profile, Gas Turbine Engine, Turbofan, Genetic Algorithm, Optimization

The Challenges Awaiting Governments Over the UAV Quest

Yaşar Gürbüz ÖZEN
Air War College,
yasar_ozen2000@yahoo.com
Hava Harp Akademisi,Istanbul,Turkiye

Gökhan Şükrü EFE
Air War College,
gefe35@gmail.com
Hava Harp Akademisi,Istanbul,Turkiye

ABSTRACT

Unmanned (Uninhabited) Aerial Vehicles (UAV) are the surprises of the millennium. In the past; radio controlled air vehicles were used for operational purposes in wars like Vietnam, however, at the beginning of 21st century there has been an exponential increase in the production and the military usage of the UAV's. Furthermore in the future, Manned Air Vehicles will work with or be replaced by UAVs in most countries.

Today, UAVs are flying over Iraq and Afghanistan or inside isolated NOTAM areas which are sufficiently distant from urban areas. The reason is that currently airspace regulations governing UAVs are very simple and insufficient. Safety considerations due to lack of regulations are huge obstacles, as well. Other than technological improvement, this is a matter of establishment of standard procedures and integration of UAVs inside the airspace control management regulations. Another concern is the legal responsibility for UAV operations. Although they are called unmanned, UAVs still rely on a human operator. Will the operator be the only suspect that will bear responsibility? For instance, what will happen if a UAV is hacked and renegades into a building or what if a UCAV kills children due to a system failure while flying autonomously?

This study explores the applicability of UAV systems into airspace management system and aims to address certain constraints about technology, concerns about flight safety and legal issues especially including air space control and management regulations. The potential bumpy areas for governments that can surface through the UAV road will be presented by analyzing the general problems faced in manned flight and rules established to avoid undesired events inside the airspace.

Keywords: UAS, UAV, UAV Airspace Integration, UAV Hijacking, UAV Hacking.

Obstacle Avoidance For Formation Of Unmanned Vehicles

Mehmet Eren Erdoğan, Mario Innocenti
Department of Electrical Systems and Automation
University of Pisa, Largo Lucio Lazzarino 1, 56122 Pisa, Italy

ABSTRACT

The paper presents a game theoretic approach to the control of a formation of unmanned vehicles. The objectives of the formation are to follow a specified trajectory and avoiding the obstacle while maintain a desired relative geometric shape among the vehicles. Formation control is implemented using game theory, with an underlined graph topology. The scenario includes the presence of obstacle, which is avoided using a Null Space Based Behavioral controller (NSBBC).

The self-enforcing Nash equilibrium can be used as the formation control strategy. In game theory, the Nash equilibrium is a solution concept of a game involving two or more players, in which each player is assumed to know the equilibrium strategies of the other players, and no player has anything to gain by changing only his or her own strategy unilaterally. If each player has chosen a strategy and no player can benefit by changing his or her strategy while the other players keep their unchanged, then the current set of strategy choices and the corresponding payoffs constitutes a Nash equilibrium. Autonomous mobile robots and vehicles can adopt this mechanism to establish their strategies to interact with other team members during the process of formation keeping

Only the leader vehicle runs the obstacle avoidance algorithm and the followers follow the leader while maintaining the formation and avoiding the obstacle. Since just the leader vehicle runs the NSBBC algorithm to avoid the obstacle, the followers do not need to have sophisticated hardware which brings several advantages e.g. freedom and flexibility on design. Thus, the formation can be assigned to wider range of missions compared to the formation groups which all the agents must have sophisticated hardware.
Keywords: *Formation control, game theory, obstacle avoidance, NS*

Autopilot Failures During Operation of the Unmanned Complex

Dimitar Jordanov
Bulgarian Academy of Sciences, Space Research Institute,
djordanov@space.bas.bg
6, Moskovska str., 1000 Sofia, Bulgaria

Svetlin Fotev
Bulgarian Academy of Sciences, Space Research Institute,
sfotev@space.bas.bg
6, Moskovska str., 1000 Sofia, Bulgaria

ABSTRACT

In the paper hereby, some of the more important results and conclusions are published that are derived through carrying out investigations regarding emergency situations the unmanned complex falls into. These are obtained by means of modeling of autopilot's typical failures in Matlab – Simulink environment. It is of practical interest to determine the situation evolution after the failure of the autopilot, excluding the operator's interference, as well as the endmost flight parameters providing that the operator has operated correctly. During the research, an unmanned complex has been modeled considering a small aircraft with mass 50 kg as an object of the control process. The height flights have been modeled at varies within 10 up to 500 meters at speed 100 km/h.

Two typical cases of autopilot failure have been investigated and called conditionally "passive" and "active." During the "passive" ones, the control signal toward the steering devices drops. This is often due to wires cutting off as well as malfunctioning wall – plugs. Deflection up to stay of the steering device and holding back in that position under the influence of a permanent, strong control signals is provisionally called "active failure." The "active" ones are distinguished by very short hidden time period. The consequences develop rapidly leading to dangerous flight parameters arising. The most likely reason for rapid deflection of the steering devices under extreme circumstances could be jamming by intensive external radio

The graphical data shown are derived at the time of autopilot's "active" failure during which the steering devices are not being given a control signal. The "passive" failure is modeled under conditions of autonomous flight according to maneuver programmed in advance. The operator is tracking the flight evolution on a monitor. In addition, conclusions are adduced which are obtained through carrying out investigations about another typical failure: the control devices deflection to the up most attitudes.

Keywords: control loop, safety.

Design and Manufacture of a Fuel Cell Powered Unmanned Air Vehicle

Unver Kaynak
TOBB University of Economics and Technology,
Department of Mechanical Engineering,
ukaynak@etu.edu.tr
Sogutozu, Ankara, 06560, Turkey

Rauf Akbaba, Alptekin Kibar
TESEM Inc.,
RAkbaba@tesem.com.tr,
AKibar@tesem.com.tr
Ankara, Turkey

Coşku Kasnakoğlu, Nilay Sezer-Uzol, Emre Güleç, Semih Tekelioğlu, Mehmet Burak Solmaz
TOBB University of Economics and Technology,
Department of Mechanical Engineering,
kasnakoglu@etu.edu.tr, nsezeruzol@etu.edu.tr, st05150026@etu.edu.tr, st05150307@etu.edu.tr,
st05150067@etu.edu.tr
Sogutozu, Ankara, 06560, Turkey

ABSTRACT

This paper describes the methodology and building steps for a fuel cell unmanned aerial vehicle design and development carried out as a university-industry cooperation project. The concept design starts with the sizing of the aircraft based on parameters used for similar aircraft in the literature. The paper includes a spreadsheet based conceptual design methodology, power and propulsion analysis, stability and control analysis, development of an autopilot, CFD and FEM analysis, and the manufacturing processes using composite materials.

Keywords: Unmanned Air Vehicle (UAV), CFD analysis, low reynolds number, Eppler 420 airfoil, FEM analysis, composite body, autopilot

Onboard Aircraft Engine FDI via Stochastic Nonlinear Modeling of Flight Variable Interrelations

D. Dimogianopoulos, J. Hios, S.D. Fassois

Stochastic Mechanical Systems & Automation (SMSA) Laboratory,
Department of Mechanical & Aeronautical Engineering,
University of Patras, GR 265 00 Patras, Greece
{dimogian,hiosj,fassois}@mech.upatras.gr , www.smsa.upatras.gr

ABSTRACT

The aim of this study is the design and the feasibility assessment of an onboard statistical scheme for engine FDI in an autonomous aircraft. The scheme is intended to complement the existing engine FDI devices for enhancing the overall FDI-related decision-making capability in a cost-effective manner. The innovation resides in that engine FDI results are obtained without modeling or monitoring internal engine quantities, such as rotor speed, local point pressures and so on. Instead, advanced nonlinear modeling techniques are used for representing critical interrelations among common flight variables (such as acceleration, thrust and so on), which are valid exclusively for aircraft with engines in "healthy" state. These interrelations are modeled by Constant Coefficient Pooled Nonlinear AutoRegressive with eXogenous (CCP-NARX) excitation representations. Their use offers multiple advantages since: a) The modeling task does not require (even partial) physics-based models; b) their stochastic operational framework explicitly accounts for modeling or measurement uncertainties; c) their pooled form allows for accurately representing the nonlinear aircraft dynamics inside an entire flight regime (unlike locally valid schemes based on detection filters or parity space representations); d) being compact-in-size, the associated FDI scheme is simpler to implement and imposes less strain on the onboard hardware resources than schemes using, for instance, multiple-models.

Once a fault affects the aircraft engine, the previously mentioned interrelations cease to be valid. Engine FDI is then performed by evaluating the fault-related information from the identified CCP-NARX representation, through proper statistical hypothesis tests. During isolation, each test is used for one fault class, meaning that, in the future, the isolation of different but sequentially occurring faults may prove possible. The scheme's performance is assessed via a large number of flights conducted with a nonlinear aircraft simulator throughout an entire flight regime under varying maneuvering profiles and engine health states.

Keywords: Fault detection and isolation, aircraft systems, stochastic nonlinear modeling, statistical decision making.

Design Process of Cevheri-3

Hasan ÇAKIR, Emre ÖZBEK, M.Burak ÖZBİLGİN, Onur ÜNLÜ, Serkan AKGÜL,
Mansur ÇELEBİ, Zafer KAZANCI, Abdurrahman HACIOĞLU
Turkish Air Force Academy, Yeşilyurt, 34149, İstanbul, Turkey
3622cakir@harbiyeli.hho.edu.tr, 3631ozbek@ harbiyeli.hho.edu.tr,
ozbilgin@harbiyeli.hho.edu.tr, 3629unlu@harbiyeli.hho.edu.tr, a.akgul@hho.edu.tr,
m.celebi@hho.edu.tr, z.kazanci@hho.edu.tr, hacioglu@hho.edu.tr

ABSTRACT

This study details the design, manufacturing and testing processes used by Turkish Air Force Academy Cevheri Team in preparation for the AIAA 2009/2010 Design/Build/Fly Competition. The goal of the competition is to design and build an unmanned, electric powered, radio controlled aircraft by maximizing total score, which is a function of report and flight score(FS). FS is determined by performance in one ferry flight mission and two payload flight mission. In one of the poyload mission, the aircraft will carry a random selection of from 6 to 10 Softballs, in the other payload mission, it will carry a random mix of "Bats". The aircraft must have high speed and low RAC in First Mission, easy loading and low RAC in Second Mission, high speed and carry more “Bats” in Third Mission. Aircraft size (one box with maximum 2x2x4 feet dimensions) and takeoff distance(100 feet) are limited by the contest rules. A score analysis on FS reveals RAC and flight velocity as the most critical design parameters.

Aircraft concepts which meet mission requirements are developed to achieve maximum FS. We used Figure of Merit (FOM) analyses to choose aircraft configuration and components and decided to design a conventional configuration with a single tractor propeller, V-tail, tail dragger langing gear. This configuration provides a lightweight, low drag design. Our configuration has a quick loading time potential because the fuselage is ahead of the wing. A high wing configuration helps our aircraft to be stable because of dihedral effect and reduces ground effects and decreases takeoff distance. V-tail allows the aircraft to have low drag and lightweight and a boom mounted tail provides great moment arm. A single-stack battery configuration is chosen for its high power to weight ratio, and a self-installing battery box is used to minimize battery installation time.

Keywords: Design process, preliminary design, optimization

Morphing Air Vehicle Concepts

Prof. Dr. Serkan ÖZGEN, Prof. Dr. Yavuz YAMAN, Asst. Prof. Dr. Melin Şahin, Asst. Prof. Dr. Güçlü Seber, Sinan KÖRPE, Evren SAKARYA, Levent ÜNLÜSOY, Tolga İNSUYU
sozgen@ae.metu.edu.tr
Middle East Technical University, Dept. Aerospace Engineering, 06531, Ankara, Turkey

Assoc. Prof. Dr. Göknur BAYRAM, Assoc. Prof. Dr. Yusuf ULUDAĞ
Middle East Technical University, Dept. Chemical Engineering, 06531, Ankara, Turkey

Assoc. Prof. Dr. Ayşen YILMAZ
Middle East Technical University, Dept. Chemistry, 06531, Ankara, Turkey

ABSTRACT

This article summarizes the current level and trends in the emerging Morphing Air Vehicle Technology. The worldwide status of the research is introduced together with proposals related to the design and development of such vehicles from aerodynamics, flight mechanics, material sciences, and structures points of view. Part I introduces the morphing concept and its potential. Part II summarizes the present technological level, while Part III discusses technological challenges and solution proposals.

Design, Analysis and Experimental Modal Testing of a Mission Adaptive Wing of an Unmanned Aerial Vehicle

Melin Şahin, Yavuz Yaman, Serkan Özgen, Güçlü Seber
Aerospace Engineering,
Middle East Technical University,
*melin@ae.metu.edu.tr
İnönü Bulvarı, 06531, Ankara, Turkey

Evren Sakarya, Levent Ünlüsoy, E. Tolga İnsuyu
Aerospace Engineering,
Middle East Technical University,
‡esakarya@ae.metu.edu.tr
İnönü Bulvarı, 06531, Ankara, Turkey

ABSTRACT

The mission adaptive wings aim to overcome the inefficient behaviour of the classical fixed wings, especially for the off-design conditions, by changing their geometry actively to adopt to changing flight conditions for maximized performance. The purpose of the flight vehicles having mission adaptive components is to fly different kinds of missions, perform effective manoeuvres and have increased fuel efficiency. In general, this can be managed via concepts creating various morphing features in the control surfaces. This study presents the structural design, analysis and experimental modal testing of an unmanned aerial vehicle wing having mission adaptive characteristics. Both the wing and its mission adaptive components, which are the hingeless control surfaces with open trailing edges, were designed by using the Finite Element Method and MSC® PATRAN and MSC® NASTRAN package programs. The mission adaptive wing then was manufactured and tested. The modal analysis of the mission adaptive wing was done with Normal Mode Analysis of MSC® NASTRAN package program. During the verification of the wing structural model it was observed that the obtained results in terms of resonance and natural frequencies were in very close agreement with the experimentally obtained values.

Keywords: Mission Adaptive Wing, Finite Element Method, Experimental Modal Testing, Unmanned Aerial Vehicle

An Adaptive Sensor Fusion Method Applied to UAV Dynamics

Halil Ersin Soken
Istanbul Technical University,
Aeronautics and Astronautics Faculty
soken@itu.edu.tr
34469 Maslak Istanbul TURKEY

Chingiz Hajiyev
Istanbul Technical University,
Aeronautics and Astronautics Faculty
cingiz@itu.edu.tr
34469 Maslak Istanbul TURKEY

ABSTRACT

In this paper a two-stage Kalman filter, which adapts itself against the system and measurement faults and secures its robustness in a similar manner, is introduced. Proposed Robust Fading Kalman Filter (RFKF) utilizes adaptive factors in order to reduce the effect of the faults on the estimation procedure. In a single algorithm, filter detects the type of the fault, either in the system or measurements, and after the fault isolation it applies the required adaptation process such that estimation characteristic is not deteriorated. Performance of the proposed RFKF is investigated by simulations for the state estimation procedure of an Unmanned Aerial Vehicle.

Keywords: robust fading Kalman filtering; state estimation; unmanned aerial vehicle.

3-D Linear Kalman Filter Tracking Unmanned Aerial Vehicle

Andon D. Lazarov, BFU, Burgas, Bulgaria
lazarov@bfu.bg

ABSTRACT

In this paper 3-D linear Kalman filter tracking is discussed. Linear time-invariant model is described with continuous-time and discrete-time state equations. Model matrices describing the behavior of the object, state vectors, measurement vectors and vector noise process with its statistical characteristic are defined. The solution for the discrete state transition matrix of the dynamic model and covariance noise matrix are given. 3-D linear time-invariant model matrices are derived. State model matrices with constant entries, measurement model matrix, state transition matrix of the dynamic model, covariance noise state matrix and covariance matrix of the measurements, are defined. Recurrent Kalman equations are described. To verify 3-D Kalman filter tracking UAV a numerical experiment is performed.

Monitoring the Health of Unmanned Aerial Vehicles

Ibrahim N. Tansel, Ming Li,Gurjiwan Singh, Gurjashan Singh, Srikanth Korla
Mechanical and Materials Engineering Department
Florida International University
Miami, FL 33174

ABSTRACT

Unmanned Aerial Vehicles (UAVs) have been widely used for military purposes and found various civilian applications. If their reliability and mishap rates are improved they may found many new applications since they could be operated in the civilian air space more confidently and do not risk the operator's life. Installation of the structural health monitoring (SHM) systems improve the reliability and decrease the operational costs since the collected information may be used for condition based maintenance of the system. In this paper, a distributed sensory signal processing system which uses the Index Based Reasoning (IBR) and using Lamb waves for the diagnostic of structural components are briefly discussed. Implementation of IBR with microcontrollers was discussed for two input and one output case. The Lamb wave based diagnostic method was used for the detection of defects (notch) of carbon fiber tubes of a small four rotor helicopter. The S transformation was used for the visualization of the experimental data. The IBR based sensory system diagnostic and Lamb wave – S transformation combinations may be implemented not only for the next generation UAVs but many other smart vehicles designed for land and sea operations could enjoy the same benefits.

Keywords: Unmanned air vehicles,structural health monitoring, index based reasoning,lamb wave, S-transformation

An Analysis Of The Perturbing Factors In The Spacecraft Motion Simulation Model

Alipbayev K., Rakisheva Z., Sukhenko A., Ahmedov D.
zaure_ra@mail.ru
Al-Farabi Kazakh National University, Almaty, Kazakhstan

ABSTRACT

The new simulation model of the spacecraft's center of mass motion with taking into account of gravitational potentials of the Earth, the Moon and the Sun is presented in this paper. The simulation model was created on the basis of analysis of the present mathematical models of gravitational potentials of the Earth, the Moon and the Sun and different methods of numeral calculation. Influence of the Earth's atmosphere, which causes the spacecraft motion deceleration, was taken into account. By means of the created simulation model the analysis of the environment perturbation factors influencing on the spacecraft motion trajectory was carried out. It has been revealed, that deviation of the calculated orbit from the given one depends on orbit height, and this dependence has been defined. The estimation of relative influence of the moments of various forces on the mass center motion was carried out.

Slow flight in the lower Mars Atmosphere in support of NASA science missions

Robert C. Michelson
Principal Research Engineer *Emeritus*
robert.michelson@gtri.gatech.edu
Georgia Tech Research Institute
Georgia Institute of Technology
Atlanta, Georgia, U.S.A.

ABSTRACT

Slow flight on the planet Mars is difficult due to the rarefied atmosphere (a low Reynolds Number regime), the lack of oxygen to support combustive propulsion, low temperature, and the low speed of sound. Flight in the anoxic, low pressure, cold lower atmosphere of Mars will be explored and viable solutions based on the Entomopter (an insect-like flapping wing, crawling vehicle) posed. The problem of efficient lift generation and controllable flight will be discussed along with proposed solutions.

Keywords: Mars; Entomopter; slow flight; reciprocating chemical muscle; unmanned aerial vehicle; UAV; autonomous flight; low Reynolds number; leading edge vortex; LEV

QB50 Mission: A pioneering project for the future networks of unmanned vehicles

Cem Ozan Asma, Jean Muylaert
Von Karman Institute
asma@vki.ac.be
Chee De Waterloo 72, B-1640 Belgium

Ruedeger Reinhard
European Space Agency
ruedeger.reinhard@esa.int
Keplerlaan 1, Leiden, Netherlands

ABSTRACT

The Lower Thermosphere up to about 350 km is the least explored layer of the atmosphere, despite their importance on many atmospheric phenomena and also for the safety of spacecrafts. They are too high for stratospheric balloons and too low for satellites due to drag by the residual atmosphere. Currently, this region is only being explored during occasional short-duration sounding rocket flights and by complex and expensive remote-sensing instruments on board satellites in higher orbits (typically 700-800 km). Space agencies are not pursuing a multi-spacecraft network for in-situ measurements in the MLT region because the cost of a network of 30-50 satellites built to industrial standards would be extremely high (over a billion Euros) and not justifiable in view of the limited orbital lifetime. No mission involving a network of satellites has been carried out in the past or is planned for the future. A network of satellite for in-situ measurements in the MLT region can only be justified by using very low-cost satellites, and CubeSats (also known as pico-satellites) are by far the best candidates.

A CubeSat is a miniaturised satellite (10x10x10 cm, weighing 1 kg) which offers all the standard functions of a normal satellite. QB50 project aims at launching a network of 50 CubeSats to orbit in the lower thermosphere region for three months and perform in-situ measurements. The QB50 project has the scientific objective of studying in situ the temporal and spatial variations of a number of key parameters in the lower thermosphere at 90-330 km altitude with a network of about 50 CubeSats, carrying identical sensors. A secondary objective is to study the atmospheric entry process by measuring a number of key parameters during re-entry and by comparing predicted and actual CubeSat trajectories and orbital lifetimes. All 50 CubeSats will be launched together on a single launch vehicle into a circular orbit at about 330 km altitude, and at an inclination of 79º. Due to atmospheric drag the orbits of the CubeSats will decay and progressively lower and lower layers of the thermosphere will be explored, perhaps down to 90 km. The initial orbital altitude will be selected so that the mission lifetime of the individual CubeSats will be about three months.

Keywords: CubeSat, Lower thermosphere, Atmospheric models, Re-entry.

Automatic 3D Reconstruction of Underwater Scenes from Uncalibrated Video Sequences

İlkay Ulusoy
Middle East Technical University,
Electrical and Electronics Engineering Department,
06531, Ankara, Turkey
ilkay@metu.edu.tr

Yavuz Kırlı,
ASELSAN, Ankara, Turkey,
mykirli@aselsan.com.tr

ABSTRACT

There are many recent studies for underwater 3D reconstruction and SLAM applications which are using 3D information obtained from stereo camera systems. In these studies the cameras are either not calibrated for their intrinsic parameters or manually calibrated either out of water or in water. If cameras are manually calibrated out of water, then their intrinsic parameter values vary when they are inserted into the water. The intrinsic parameters are influenced by temperature, salinity, pressure or wavelength in aquatic environment. Thus, intrinsic camera parameters should be estimated for the environment where the camera is on duty. This can be done by calibrating the cameras in water by using calibration patterns immersed in the water. However, manual calibration under water is not convenient especially when it should be repeated many times. For example, if the cameras are moved to different environments which have different water turbidity, pressure, temperature, salinity, wavelength, from the environment in which it is calibrated, the calibration must be repeated in the new environment.

Because of these problems, it is very important to automatically estimate the intrinsic camera parameters as well as the extrinsic parameters in water where the camera is supposed to record. Automatic (self) calibration does not need for a special calibration pattern and a special session for camera calibration. Thus, it can be repeated whenever and wherever necessary. The camera can be calibrated by using some frames of the recorded video which have proper texture information and this calibration information can be used for the whole video in order to perform further tasks such as 3D reconstruction and SLAM. However, the parameters can be estimated up to a scale factor. But in underwater applications, since there are some other sensors accompanying the cameras and distance information can be acquired via these sensors, this scale factor can be estimated.

In this study, automatic camera calibration and automatic 3D reconstruction are performed for underwater applications.

Keywords: underwater, self-calibration, 3D reconstruction.

Development of Mini Scale Autonomous Robot Grader for Road Constructions

Önder Halis Bettemir
Yuzuncu Yil Universitesi, ohbettemir@yyu.edu.tr
Civil Engineering Department Yüzüncü Yıl University
Van Turkey

ABSTRACT

In this study development of a mini scale autonomous grader with limited grading capability is proposed. The mini scale autonomous grader is aimed to be capable of performing grading actions for the road and canal constructions without taking any directions or commands once the project data are loaded on its mini computer.

The mini scale grader has a Personal Digital Assistant (PDA) computer as a central control unit in which the project data, geological data, topography, machine specifications and optimization software are loaded. The optimization software develops the optimum or near optimum schedule by considering the project data, machine specifications, topography and geological data. Once the schedule is formed, the autonomous grader executes the schedule by self-controlling its position by means of an on board DGPS receiver. The control unit computes and executes necessary adjustments for the position and direction of the grader, and the alignment of the grader blade.

The mini scale grader is powered by two DC electric motors. The aim of using two electrical motors for the traction is to avoid using differential direction system for the turning mechanism. Power source of the grader is a large rechargeable battery consisting of eight 12V batteries. The grader blade is aligned by two servo electrical motors. Similarly the direction of the front wheels is also controlled by two servo electrical motors.

The advantages of the autonomous grading system can be listed as low operating cost in terms of both personnel and energy, improved job security, ability of performing tasks in any kind of weather conditions.

Keywords: Machine control, road construction, automation, information technologies in construction, autonomous robot.

Development of Autonomous Underwater Vehicle (AUV) Navigation System Based on Kalman Filtering Technique

Mustafa Dinç
Department of Aeronautical and Astronautical Engineering
Istanbul Technical University (ITU)
mdinc1972@gmail.com
Ayazağa Yerleşkesi, Maslak, İstanbul/TURKEY

Chingiz Hajiyev
Department of Aeronautical and Astronautical Engineering
Istanbul Technical University (ITU)
haciyev@itu.edu.tr
Ayazağa Yerleşkesi, Maslak, İstanbul/TURKEY

ABSTRACT

The research on underwater systems has gained an immense interest during the last decades with applications taken place in many fields. Therefore, the significant number of underwater vehicles has been created for the solving of wide spectrum of scientific and applied tasks of ocean development and research in the world; however, this is a new research area for Turkey, where there are only a few ongoing projects on underwater systems yet.

Underwater vehicles require a precise navigation system for localization, positioning, path tracking, guidance and control. Problems concerning autonomy and navigating especially in unfamiliar environments and maneuvering autonomously to avoid obstacles are perhaps most serious and have yet to be fully solved.

This article is primarily focused on modeling of high speed Autonomous Underwater Vehicles (AUVs) and development of navigation system based on new Kalman filtering technique. Modeling of underwater vehicles involves the study of statics and dynamics. The navigation system of underwater vehicles plays a crucial role together with the sensor architecture in the degree of system autonomy that can be achieved.

Keywords: AUV Modeling, Inertial Navigation System, Kalman Filtering, Extended Kalman Filter

A Systematic Design and Integration Approach for the Development of an Unmanned Underwater Vehicle

Tuğrul ADIGÜZEL
Ahmet AKBULUT
A. Egemen YILMAZ
Ankara University Faculty of Engineering
Department of Electronics Engineering
{adiguzel, aakbulut,aeyilmaz}
@eng.ankara.edu.tr

Özgür YILDIZ
Bülent GÖKALP TR Teknoloji Ltd. Şti.
{ozgur.yildiz,bulent.gokalp}
@gateelektronik.com.tr

ABSTRACT

Unmanned Underwater Vehicles (UUVs) have found numerous applications for civil or military purposes recently. Especially for the countries with wide coastlines, using a large number of cost effective and relatively small underwater vehicles provide high capability to overcome numerous potential problems like coastline/harbor security, bathymetric measurements, oceanographic surveys as well as offshore oil platform, cable and pipeline development and maintenance activities. In this paper, a framework and the necessary design steps for development of a UUV (particularly a ROV, depending on our experience) are briefly described.

Keywords: Unmanned underwater vehicles, remotely operated vehicles, control.

Hydrogliding – A Fuel-Efficient Mode For Underwater Auv Propulsion

Deniz Ünsalan
Piri Reis University, Tuzla, İstanbul, Turkey
denizunsalan@yahoo.com

Kunsel İZET-ÜNSALAN
Ovidius University, Constanta, Romania

Stelian GALETUSE
"Politehnica" University of Bucharest, Academy of Romanian Scientists

ABSTRACT

Hydrogliding is a mode of propulsion used by undersea vehicles at rather low velocities, with virtually no consumption of fuel. It is a concept that has been considered and also demonstrated by several designs and existing prototypes for the propulsion of Underwater Autonomous Unmanned Vehicles (UAUW's) to collect oceanographic data from various depths and from remote locations, thereby obtaining sets of three-dimensional profiles. The propulsion of hydrogliders are maintained by relatively small changes in the absolute value of the buoyancy, as well as the location of centre of buoyancy relative to the centre of gravity. The track followed by the hydroglider shall resemble a sawtooth shape.
This paper discusses about the hydrodynamics, ways of provision of buoyancy, and events to be followed during a mission, and about the navigation of the vessel, illustrating a concept conceived by the authors.

Development of a Steered Unmanned Ground Electric Vehicle Research Platform

Gökhan Bayar
Middle East Technical University,
Mechanical Engineering Department,
bayar@metu.edu.tr
İnönü Bulvarı, 06531,
Ankara / TURKEY

A. Bugra Koku
Middle East Technical University,
Mechanical Engineering Department,
kbugra@metu.edu.tr
İnönü Bulvarı, 06531,
Ankara / TURKEY

E. ilhan Konukseven
Middle East Technical University,
Mechanical Engineering Department,
konuk@metu.edu.tr
İnönü Bulvarı, 06531,
Ankara / TURKEY

ABSTRACT

An autonomous unmanned ground vehicle should be able to decide on its own and tune itself to accommodate to changing conditions. Hence, it has to respond to its workspace environment properly without requiring any help. Such a vehicle should be able to sense and model its surroundings to a sufficient degree, position itself in its workspace, determine the necessary trajectory to accomplish a desired task and follow this path. Considering the variety of applications where mobile robots are used, an autonomous vehicle that can operate on a wide range of terrain is desirable. Hence, vehicles with serious off-road capabilities such as ATVs (All Terrain Vehicles) are commonly preferred by mobile robot researchers and converted into UGVs (Unmanned Ground Vehicles). In this paper, development of a UGV built as a research platform and its preliminary performance test results are introduced.

Keywords: ATV, UGV, vehicle, unmanned, development, platform.

STRUCTURAL DESIGN OF A QUADROTOR

Çağrı ÇIKRIKÇI
Turkish Air Force Academy,
Aeronautical Eng.Dep.
3113cikrikci@harbiyeli.hho.edu.tr

Erol ER
Turkish Air Force Academy,
Aeronautical Eng.Dep.
3116er@harbiyeli.hho.edu.tr

A.Görkem ARISOY
Turkish Air Force Academy,
Aeronautical Eng.Dep.
3117arisoy@harbiyeli.hho.edu.tr

H.Görkem ÖZKAN
Turkish Air Force Academy,
Aeronautical Eng.Dep.
3131ozkan@harbiyeli.hho.edu.tr

Evren ÖZŞAHİN
Turkish Air Force Academy,
Aeronautical Eng.Dep.
e.ozsahin@hho.edu.tr

Halit S. TÜRKMEN
İstanbul Technical Univ.,
Faculty of Aero. and Astro. Eng.
halit@itu.edu.tr

ABSTRACT

Unmanned Aerial vehicles (UAV's) are aircrafts capable of flight without an on-board operator. Such vehicles can be controlled remotely by an operator on the ground, or autonomously via a pre-programmed flight path. UAV's are already being used by the military for recognizance and search and rescue operations. In the last few years, the UAV in the quadrotor configuration has been highlighted in a lot of papers. Among these papers, the number of studies about statically and/or dynamically structural analysis of a quadrotor is very limited. In this study, an initial design of a quadrotor was carried out. For this purpose, the static and dynamic analyses were performed using ANSYS finite element software. The structure of the quadrotor is mainly made of composite materials. The structure is modeled by using beam and shell elements. In static analysis, two different load cases are considered. The deflections and stresses on the structural components are computed. The structural components are modified to obtain the reliable structure with minimum weight. In the dynamic analysis, the free vibration frequencies are determined. The numerical results are presented and concluded. Keywords: Quadrotor Helicopter, Buckling Analysis, Structural Optimization, Finite Element Method, Unmanned Aerial Vehicles.

An Intelligent PID Tuning Method for an Autonomous Mobile Robot

Alpaslan Yufka
Eskisehir Osmangazi University, Eskisehir
Department of Electrical and Electronics Engineering
ayufka@gmail.com,
Bati Meselik, 26480, Eskisehir, Turkey

Ahmet Yazıcı
Eskisehir Osmangazi University, Eskisehir
Department of Computer Engineering
ayufka@gmail.com,
Bati Meselik, 26480, Eskisehir, Turkey

ABSTRACT

In this study, a Best First Search (BFS) Based Intelligent PID Tuning Method is proposed for a mobile robot path tracking problem. BFS is an informed search strategy in Artificial Intelligence (AI). It has been used in many areas of intelligent systems. Here, it is used to search values of both ultimate period and ultimate gain of Ziegler-Nichols (ZN) PID Tuning Method. So, using these ultimate period and gain, PID parameters can be c from tables of ZN method. The performance measure in this problem is described as minimizing total error during any specified trajectory tracking. Thus the proposed method does not depend on the system model. It only needs error information during the tracking control. So, this method can be used to tune PID parameters of any tracking controller for a system with unknown system dynamics. The proposed method is tested with simulations in MATLAB during trajectory tracking of a mobile robot. In addition, it is compared with classical PID and conventional PID tuning methods including Ziegler-Nichols method, Tyreus-Luyben method, and Shinskey method.

Keywords: Intelligent PID tuning, best first search, autonomous mobile robot, mobile robot path tracking problem, computed torque PID control, dynamic model, Ziegler-Nichols, Tyreus-Luyben, Shinskey.

Cooperative Transportation by Multiple Autonomous Non-holonomic Mobile Robots

Alpaslan Yufka
Eskisehir Osmangazi University, Eskisehir
Department of Electrical and Electronics Engineering
ayufka@gmail.com,
Bati Meselik, 26480, Eskisehir, Turkey

Metin Özkan
Eskisehir Osmangazi University, Eskisehir
Department of Computer Engineering
meozkan@ogu.edu.tr,
Bati Meselik, 26480, Eskisehir, Turkey

ABSTRACT

In this study, motion planning and control scheme for a cooperative transportation system, which consists of a single object and multiple autonomous non-holonomic mobile robots included forklifts, is proposed. Virtual leader-follower formation control strategy is used for the cooperative transportation system. The object is assumed as the virtual leader of the system and the robots carrying the object on their forklifts are considered as follower robots. A smooth path is generated by considering the constraints of the virtual robot. The origin of the coordinate system attached to the center of gravity of the object tracks the generated path. A path for each follower robot is generated to keep the formation structure. The follower robots track their paths. A communication framework is used for the messaging between robots, and asymptotically stable tracking control is used for trajectory tracking. The proposed method is verified with real applications and simulations using Pioneer P3-DX mobile robots and a single object.

Keywords: Cooperative transportation, formation, motion planning, tracking control, formation, multiple robots, forklift.

Unmanned Systems Endowed with Attention

Özgür Erkent
Boğaziçi University, Electrical&Electronics Engineering ozgur.erkent@boun.edu.tr
Bogazici University, Electrical&Electronic Engineering Intelligent Systems Lab. Bebek 34342Istanbul Turkey

Işıl Bozma
Boğaziçi University, Electrical&Electronics Engineering bozma@boun.edu.tr
Bogazici University, Electrical&Electronic Engineering Intelligent Systems Lab. Bebek 34342Istanbul Turkey

ABSTRACT

In this paper, we present our research in autonomous systems that seeks to understand the theoretical and operational principles of attentive robotic vision. If the robot is to have autonomy,its vision system must be capable of doing real-time and robust scene recognition in different environments.The preliminary research presented here takes a highly abstracted look at this problem. Our starting point is that attentive vision requires developing rigorousconnections between the robot's head and body motion and its imperfectlymodeled and sensed environment. Our approach applies this principle in all the three different stages of attentive vision: pre-attention, attention and cognition. For pre-attention where the robot has to determine where to look next, a family of artificial potential functions form the mathematical basis that models how the robot's head move depending on what it is currently seeing. The same principle also affects attention which is focused on representation and cognition which is associated with how to use this representation in visual tasks. We propose to employ bubble spaces as the basis for the scene representation and recognition simultaneously.

Keywords: Attentive robots, visual recognition, pre-attention, autonomous mobile robots.

A Family of Unmanned Rotorcraft Systems for Versatile Missions

Hasan Ibacoglu [1], Aytekin Guven [1], Taner Mutlu [1], Kerem Anbarci [1],
A. Rustem Aslan [1,2] and H. Temel Belek [1,3]
1 Rotorcraft Centre of Excellence, Faculty of Aeronautics and Astronautics,
2 Department of Space Engineering, Faculty of Aeronautics and Astronautics,
3 Department of Mechanical Engineering, Faculty of Mechanical Engineering,
Istanbul Technical University, Maslak, Istanbul, Turkey
Phone: +90 212 2857189
Email: aslanr@itu.edu.tr

ABSTRACT

Importance of the Unmanned Aerial vehicles is being increasing because of their advances on both in civilian and military usage. UAV's are the most dynamic sector of the aerospace industry. Istanbul Technical University Rotorcraft Center of Excellence called ITU-ROTAM is developing a family of unmanned rotorcraft systems (RIHA) which are suitable for the market requests. ITU-ROTAM is continuing with testing and re-designing/improving activities of the RIHA1 which has a payload capacity of 25 kg. The conceptual design of the larger size members of the RIHA family, RIHA2 and RIHA3 with payload capacities of 50 kg and 100 kg, is finished. In this paper, the RIHA family is described along with national needs and requirements.

HILSim for Attitude Control of a Quadrotor

M.K.BAYRAKÇEKEN, M. ILARSLAN and A.ARISOY
Air Force Academy, Dept. of Electronics Eng., Istanbul, TURKEY

A. KARAMANCIOĞLU
Osmangazi University, Dept. of Electrical &Electronics Eng. Eskisehir, TURKEY

ABSTRACT

In this study, a Hardware In the Loop Simulator (HILSim) is introduced for attitude control of a Quadrotor. It is presented HIL Sim as an experimental setup for attitude control of a Vertical Take-Off and Landing (VTOL) system called Quadrotor. Quadrotor is the helicopter with four rotors. The collective input (or throttle input) is the sum of the thrusts of each motor. This design approach increased the stability and controllability of the mini unmanned air vehicle (UAV). Linear control methods are applied to attitude control of this UAV and designed controllers are tested using HILSim in laboratory environment. The HILSim includes hardware and software. An underactuated system in the sense that there is fewer control inputs than degree of freedom. Dynamic equations of the quadrotor cannot be decoupled due to the highly nonlinear structure. Control of these systems is challenging and attractive for researchers in this area. Pure computer simulation is not sufficient, on the other side setting up of the real controlled system is not cheap and practical to implement derived algorithms. Therefore, HIL simulation approach is sufficient to improve and implement control algorithms. The performance evaluation of the derived controllers can be implemented and required gain constants can be tuned easily for different cases in real-time using a HILSim designed for Quadrotor. The described HIL simulation environment is shown to be useful for analyzing and evaluating designed controller for VTOL UAV.

A Real-time SLAM Algorithm with Optical Flow based Motion Extraction for Autonomous Robot Navigation

Onur SENCAN, Mert TURANLI, Evangelos SARIYANIDI
Robotics Laboratory at Control Engineering Department, Istanbul Technical University,

Sefer KURNAZ
Turkish Air Force, Aerospace, Science and Technologies Institute.

Hakan TEMELTAS
Control Engineering Department, Istanbul Technical University, 34469 Turkey.

Seta BOGOSYAN
Electrical And Computer Engineering, University of Alaska Fairbanks, 99775 USA.

ABSTRACT

In this study we present a method for the localization problem of autonomous vehicles in the case study of well known Simultaneously Localization and Map Building (SLAM) problem. Methods that are using odometer and IMU together still open to development because of incapability of obtaining significant noise-free measurements from ordinary IMU sensor. Nowadays modern techniques are using additional vision for correction issue due to their spatial and temporal continuity property which is useful for implementation of estimation tools such as Kalman filter. Our work is based on optical flow-based motion correction of odometry and IMU measurements together. The proposed method is tested on an experimental test bed with differential drive wheels platform and various sensors.

LQR Controller With Kalman Estimator Applied To UAV Longitudinal Dynamics

S.Yenal Vural

Istanbul Technical University, Faculty of Aeronautics and Astronautics,

vurals@itu.edu.tr

Maslak, 34469, Istanbul, TURKEY

Prof. Dr. Chingiz Hajiyev

Istanbul Technical University, Faculty of Aeronautics and Astronautics,

cingiz@itu.edu.tr

Maslak, 34469, Istanbul, TURKEY

ABSTRACT

The aim of this study is designing an optimal controller with linear quadratic regulator (LQR) method for a small unmanned air vehicle (UAV). To better evaluate the effect of disturbances on the obtained measurements a Kalman filter is also used in the system. For this purpose a small UAV that is normally used as a radio controlled plane is chosen. The linearized equations for a wings level flight condition and the state space matrices are obtained. An optimal controller using linear quadratic regulator method to control the altitude level is then designed. The effect of the disturbances on the measurements are taken into account and the effectiveness of the Kalman filter in obtaining the correct measurements and achieving the desired control level are shown using the controller designed for the system. The small UAV is commanded to the desired altitude using the LQR controller through the control inputs elevator deflection and thrust rate. The LQR effectiveness matrices are chosen to find the gains necessary to build an effective altitude controller. Firstly the controller is tested under the situation where disturbances are absent. Then a Kalman filter is designed and the system under disturbances is tested with the designed controller and the filter. The results reveal the effectiveness of the Kalman filter and the LQR controller.

Keywords: UAV, LQR control, Kalman filtering technique, Altitude controller

Collaboration among Multiple Unmanned Aircraft Systems to Search, Detect, and Locate Ground Targets

Daniel Pack, Dimitri Zarzhitsky and Hyukseong Kwon
Department of Electrical and Computer Engineering
US Air Force Academy, CO 80840
{daniel.pack,dimitri.zarzhitsky,hyukseong.kwon@usafa.edu}

ABSTRACT

This paper presents results from several stationary ground target localization experiments performed using a distributed, cooperative, heterogeneous sensor network designed, implemented, and flight demonstrated at the US Air Force Academy. This sensor network consists of stationary ground sensors, as well as mobile ground and aerial sensor platforms equipped with visual and thermal cameras, in addition to radio frequency signal detectors. The experiments demonstrate in a quantifiable manner how sensor multiplicity and diversity contribute to the reduction of target localization error. The paper also provides a brief overview of key technologies that form the foundation of our sensor network, consisting of a multi-threaded operating system, an out-of-order sigma-point Kalman filter, and a decentralized controller for cooperative unmanned vehicles.

Performance Analysis of Formation Flight Control over Fading Communication Channels

Adrian-Mihail Stoica
Faculty of aerospace engineering, University "Politehnica" of Bucharest, Romania
amstoica@rdslink.ro
Str. Polizu, No. 1, Bucharest, Ro-011061, Romania

Bogdan Donciu
Romanian Air Traffic Services Administration, 10, Ion Ionescu de la Brad Blvd., P.O. Box 18-90, Ro- 013813, Bucharest, Romania

Stelian Găletuşe
Faculty of aerospace engineering, University "Politehnica" of Bucharest, Academy of Romanian Scientists, Romania
stelian_galetuse@yahoo.com
Str. Polizu, No. 1, Bucharest, Ro-011061, Romania

ABSTRACT

The paper presents a method for the analysis of the influence of the fading communication channels approximated by stochastic Rice models, over the performances of formations of unmanned aerial vehicles, concerning trajectory tracking and geometry formation keeping. The proposed approach is based on the computation of the H-infinity and H_2 type norms for discrete-time stochastic systems with multiplicative and additive noise. The theoretical developments are illustrated for the automatic control system of a formation flight for which the influence of the intensity of multiplicative noise and of the sampling period are analyzed.

Keywords: Formation flight, fading communications channel, discrete-time stochastic model, multiplicative and additive noise, H-infinity and H_2 norms.

A Case for the Development of Models to Capture the Dynamical Responses to UAV Surveillance and Engagement Actions

Peter J. Sherman,
Iowa State University, Ames, IA 50011, U.S.A.
shermanp@iastate.edu

ABSTRACT

The proliferation of UAVs represents a paradigm shift in relation to both passive surveillance and active engagement in military and non-military settings. Currently, most surveillance and all engagement maneuvers are controlled by a remote human operator, with the assistance of a team that monitors the streaming video data. Even at this early stage, the amount of data is enormous. As more cameras are utilized it will be necessary to implement autonomous decision rules for surveillance and engagement. In this paper we make a case for the development of multi-dimensional mathematical dynamical models of individuals, groups of people, and nations, that would assist in autonomous decision-making processes. The dimensions of the model would include emotional, economic, political and military variables. Furthermore, they would be time-varying Bayesian models that would take advantage of response data associated with prior responses while incorporating current and future anticipated climates related to these variables.

To date, we have seen an array of strong responses to the use of drones in Afghanistan and Pakistan. Many of them have been negative. Early studies of the mindsets of not only recipients of surveillance and engagement, but also of those who direct the same, point to the need to better understand and accommodate these mindsets. This understanding is essential in order to permit UAV developments to continue in a responsible sustainable manner. The models proposed in this paper would requires highly interdisciplinary teams of researchers from areas including, but not necessarily limited to, personal and social psychology, political science, economics, statistics, and systems engineering. This team would need to work hand-in-hand with engineers and scientists involved with the technological developments.

As daunting as this task of developing such models may seem, even more daunting is the task of sustaining responsible and effective use of UAVs without them.

Assessment of Expertise Development and Cognitive Workload of UAV Operators in a Simulated Environment: A Functional Brain Imaging Approach

Murat Perit Çakır, Justin Menda, Hasan Ayaz, Kurtuluş İzzetoğlu, Banu Onaral
Drexel University
Cognitive Neuroengineering and Quantitative Experimental Research (CONQUER) Collaborative
School of Biomedical Engineering, Science and Health Systems
{mpc48, jm973, ha45, ki25, bo26}@drexel.edu
3508 Market Street, Philadelphia PA 19104

ABSTRACT

As the use of unmanned aerial vehicles expand to near earth applications and force multiplying scenarios, current methods of operating UAVs and evaluating pilot performance need to expand as well. Many human factor studies on UAV operations rely on self reporting surveys to assess the situational awareness and cognitive workload of an operator during a particular task, which render comparisons made between operators subjective. Functional Near-Infrared Spectroscopy (fNIR) is an emerging optical brain imaging technology that monitors brain activity in response to sensory, motor, or cognitive activation. fNIR systems developed during the last decade allow for a rapid, non-invasive method of measuring the brain activity of a subject while conducting tasks in realistic environments. This paper investigates deployment of fNIR for monitoring UAV operator's cognitive workload and situational awareness during simulated missions. The experimental setup and procedures are presented with some early results supporting the use of fNIR for enhancing UAV operator training and evaluation

Keywords: UAV, Optical Brain Imaging, fNIRS, Cognitive Workload, Expertise Development

Development and Applications of the Unmanned Vehicles

Sefer Kurnaz
The Aeronautics and Space Technologies Institute Air Force Academy, e-mail: kurnazsefer1@yahoo.com, Tel.: 90-212-6632490, Istanbul, Turkey

Rustam B. Rustamov
Institute of Physics of the Azerbaijan National Academy of Sciences, e-mail: r_rustamov@hotmail.com, Tel.: (994 12) 497 80 80, Baku, Azerbaijan

ABSTRACT

High resolution aerial photographs have important rangeland applications, such as monitoring vegetation change, developing grazing strategies, determining rangeland health, and assessing remediation treatment effectiveness. Acquisition of high resolution images by Unmanned Aerial Vehicles (UAVs) has certain advantages over piloted aircraft missions, including lower cost, improved safety, flexibility in mission planning, and closer proximity to the target.

Phases in the Autopilot Development

Sabin CODREA
Military Equipment and Technologies Research Agency/ROMANIA

Corneliu AXENTE
Military Equipment and Technologies Research Agency /ROMANIA
cornell2you@yahoo.com

ABSTRACT

The paper presents steps and the followed route for the development of autopilot equipment (SPARTACUS 4) available for different types of aerial platforms. The development driven function was the reliability and the low cost of the equipment.

The main purpose of the autopilot is to enable the unmanned aircraft to accomplish their mission autonomously, without any (or with minimal) input from the operator. This leads to the fact that unmanned platform's performances are highly dependent on autopilot functions and reliability. This dependence is more demanding in case of multiple software functions implemented (waypoints navigation, datalink, return home or failsafe procedures etc.) on the same autopilot architecture or in the case of large flight parameter range (aerial targets, loitering UAV's etc.) or in case of a low workload operator available for piloting and navigation. An autopilot is using the aircraft state, position and attitude information provided by the on-board sensors to drive the control surface actuators (servos), turreted sensor actuators or other predefined on/off peripherals (parachute lock device, airbag activation).

During the autopilot development phases several types of attitude sensors were used and tested including an IR sensors board based architecture. Also the processing module was upgraded from 8/16 bits core microcontrollers to a 32 bits core, in order to balance the need for flight safety with as few as possible external constrains and the low cost development driven function.

Regarding the SPARTACUS 4V – IN (V-version/IN-inertial) autopilot architecture, here in display, was build up around on a 32 bits ARM core microcontroller processing unit and an IMU (inertial measurement unit) based on low cost inertial sensors (accelerometers and gyros). The autopilot is capable to perform the following functions:

- ✓ Predefined waypoints flight plan;
- ✓ Trajectory intersection computation;
- ✓ Gains and filter configuration are made from the ground control station.

The Ground Control Station (GCS) is an acclimatized mobile system composed by 2 computers with 4 video monitors.

Current paper presents the basis of the implemented math algorithms (Chebyshev and Kalman filters algorithm, Taylor series expansions) used for sensor data fusion and the command and control loop. The block architecture utilized in SPARTACUS 4 family autopilots can be used to command and control several kinds of platforms applications such as:

- Boreal 5/ MM Şoim – low to medium speed platforms;
- MM Delta – high speed, low stability platform;

Also, the presentation will present some particular aspects during flight tests. Briefly, these concern the robustness of the return home algorithm, the datalink signal strength and stability or the gyros rate speed limits.

The practical part of the presentation will include an application of the autopilot stabilization capability to gyro-stabilize a 2 axis gimbaled turreted video camera.

Primary development driving functions are:

- simplified math algorithms (minimal number of parameters within the stability matrix);
- high frequency 32 bits microcontroller based architecture; Low cost and time implementation.

Systems Engineering in UAV Development

A.Bahar HASER A.Erdem KAZAKLI Seçkin ARIBAL TAI, UAV Systems Division, TAI, UAV Systems Division, TAI, UAV Systems Division, bhaser@tai.com.tr ekazakli@tai.com.tr saribal@tai.com.tr Fethiye Mahallesi Havacılık Fethiye Mahallesi Havacılık Fethiye Mahallesi Havacılık Bulvarı, Kazan/ANKARA Bulvarı, Kazan/ANKARA Bulvarı, Kazan/ANKARA

ABSTRACT

Systems Engineering discipline focuses on clarifying stakeholder requirements and the functions that the product is expected to execute, managing requirements, functional and physical analysis and validating the final product, considering the whole product beginning from the feasibility stages. For complex and multi-system/multi-interface design processes like UAV Systems design, Systems Engineering has a vital role such as coordinating technical and managerial interfaces.

Keywords: Systems of Systems, UAV, Systems Engineering, Vee Model.

Safety Process Application in Unmanned Air Vehicle Development Programs

Sirma CELIK, (scelik@tai.com.tr)
Zeynep KOCABAS, (zkocabas@tai.com.tr)

TAI-Turkish Aerospace Industry Fethiye Mah. Havacilik Bulv. No: 17 06980 Kazan /Ankara/ Turkey
Phone: +90 312 811 1800/7430

ABSTRACT

Recently, with the improvement of technology in aircraft design, the implementation of Unmanned Air Vehicle (UAV) operations in the military applications as well as civilian and commercial aims has been increased dramatically. This fact brings UAV's outside of their restricted particular area where their operation is allowed for the sake of flight safety of all air vehicles; and integrates them into the manned vehicle's airspace. Naturally a common expectation of those UAV's having the equivalent level of safety as the manned air vehicles happen to be obvious.

Since recently developed UAVs compromise highly complex systems such as autopilot, sensors, airframes and embedded computing platforms, safety analysis of those intelligent systems become more and more important. Besides, with the integration of the ground base systems and available data links, the system safety analyses grow to be very challenging. From the time when these intelligent systems, autopilots and computing platforms are included, software also turned out to be important within the safety point of view when compared to the manned aircrafts. Software is responsible for controlling the air vehicle and providing the blended data from the equipments on the air platform to autopilot and ground station. This fact results in more reliable software necessity. Moreover, remote control of the air vehicle gives no chance to recognize any failure via pilot sensing, such as: noise, smell, vibrations etc. Therefore, failure cases may not be detected beforehand, which leads more critical repercussions.

Although the civil operations of the UAVs has been increasing, available examples of system safety analysis can not be found easily since the subject literature is based on military illustrations. Therefore, similarity method which is a very commonly used technique in system safety assessments can not be implemented as frequently as manned aircrafts.

Today, the current Class A mishap rates of UAV systems is approximately two orders of magnitude poorer that human-piloted aircraft (10-5-10-7) which still brings a limitation of their operational area [1]. Therefore, flight/system safety analysis applications during the design phases turn out to be inevitable.

There are a number of studies and even regulations which propose safety objectives for UAV systems [1]. Although there exist a continuous improvement and updates available in literature regarding the subject, still some main concerns about the accomplishment of flight system safety and airworthiness issues of the UAVs are missing. For that reason, different approaches and methods may be applied during the safety analysis of the UAV design process, according to the operational areas of the UAVs.

This paper highlights, system safety analysis process implemented during the design phase of a Middle Altitude Long Endurance (MALE) UAV. Since available regulations do not completely meet the needs, additional rules such as requirements, engine analysis, UAV level and system level assumptions etc. are applied and these supplementary rules are clearly described hereby. Critical systems, lessons learned and suggestions are also clarified explicitly. In addition, subcontractor safety management as well as answering the customer needs while defining safety targets is enlightened. This paper also includes temporary precautions taken for the test flights for which the UAV will have different configurations. The interactions of the system safety process with other air vehicle design disciplines are also mentioned.

Target Drones And Development Efforts In Turkey

Yener ÇETİN
TAI-Turkish Aerospace Industries Inc.,
ycetin@tai.com.tr
Fethiye Mahallesi Havacılık Bulvarı No.17 06980
Kazan ANKARA TÜRKİYE

ABSTRACT

Demand for Unmanned Air Vehicles (UAV) keeps increasing every day. All industrialized countries, which are developed in aerospace and electronics, design and develop their own UAV systems in order to be independent in capabilities, gathering information and intelligence. The reason for using UAVs is the systems ability to provide armed forces; intelligence, surveillance, reconnaissance, attack and training without risking human life. Reasons are named 3D (Dirty, Dull & Dangerous) missions that manned aircrafts are expensive or risky to use. One of these missions is they are used as targets in the training for air defense systems. All armed forces worldwide aim to be ready for homeland security with trainings in peacetime. Defense force capabilities are improved by implementing more realistic trainings. The characteristics of enemy fighters and missiles can be simulated successfully in the air defense units' firing and tracking air to air and surface to air trainings by target drones. In its simplest form target drones often resemble radio controlled model aircraft. More modern drones sometimes use counter measures, radars and similar devices to mimic real aircraft. And the technology of target drones leads us to Air Defense Suppression Drones and Decoys. UAVs and Target Drones' history started 15 years after manned flight. In early 1980s, unmanned target systems from abroad started to take place in Turkish Armed Forces inventory and regular purchasing continued in the following years resulting in foreign dependence. To stop foreign dependency and meet the demands domestically, TAI launched target drones development project in 1995. Now systems like TURNA & KEKLİK is actively used in all branches of Turkish Armed Forces all over Turkey. To meet the potential demand for higher speed target drones, TAI started ŞİMŞEK target drone development project in 2009. TAI, with the knowledge gained in 15 years experience, is determined to meet Turkish Armed Forces' all air defense target system needs.

Keywords: Target Drone, Air Defense

Challenges in The Aerodynamic Design of a UAV

Gürkan ÇETİN
TAI – Turkish Aerospace Industries
Air Vehicle General Design Department
gcetin@tai.com.tr
TUSAŞ – Türk Havacılık ve Uzay Sanayii A.Ş.
Havacılık Bulvarı No:17, Akıncı, Kazan, Ankara, Türkiye

ABSTRACT

The Turkish Indigenous Medium Altitude Long Endurance (MALE) Unmanned Aerial Vehicle Development Program aims to develop a medium altitude long endurance UAV system for persistent reconnaissance missions on the Turkish land. The UAV is designed to stay aloft for 24 hours, and has a service ceiling of 30,000 feet. These mission requirements have been the top level design drivers for many disciplines, in particular the aerodynamic design of the aircraft configuration. This paper presents some of the challenges faced through the development phases from the designer's perspective.

Turkish MALE UAV Development Program

Remzi Barlas
Şenol Sergen
Tarkan Karşıdağ
TAI -Turkish Aerospace Industries Inc.
Fethiye Mah., Havacilik Bulvari No: 17
06980 Kazan, Ankara

ABSTRACT

TAI has been developing a Medium Altitude Long Endurance (MALE) class UAV system initially to fulfill basic RSTA missions. The system consists of Air Vehicles, Ground Control Station, Datalink and Automatic Landing subsystems. The system will have full autonomous flight capabilities including take-off and landing.

The Air Vehicle configuration is composed of a fuselage, detachable left and right wings, and detachable V-tail surfaces. All structure is made of composites except some frames and fittings. A pusher type heavy fuel piston-prop engine is utilized for propulsion and electrical power generation. Retractible landing gear is used to minimize the aerodynamic drag for better mileage which is crucial for long endurance missions.

The Air Vehicle is designed to carry two primary payloads (P/L) in its two separate P/L bays; a high resolution EO/IR/LD/LRF payload in the Front P/L Bay and a SAR/ISAR-MTI payload in the Aft P/L Bay. All other aircraft subsystems are located in five different compartments, namely; forward avionics, fuel, aft avionics, electrical systems and engine compartments. All compartments are divided by frames from each other on a monocoque lower skin.

All flight critical control system components including control surfaces and actuators are dual redundant. A state of the art flight control computer manages all aircraft subsystems either autonomously or thru commands from the Ground Control Station (GCS).

The airborne and the ground segments of the integrated avionics system have been integrated around an architecture that prioritizes reliability, open system, cost and availability requirements of the program. TİHA mission suite have been carefully segregated, in the air and on ground, from the flight critical components for reliability and to allow future system integration upgrades with lesser impact on the flight critical components. The redundant data link architecture also provides the necessary bandwidth for the mission and flight control functions via open interface standards.

The mobile GCS, housed in a NATO Standard shelter, also includes two command and control stations that can substitute each other for flight and mission management

functions. The GCS can also be integrated with other Turkish Armed Forces C4I Networks through NATO Standard interfaces for mission planning and monitoring needs.

The system complexity level, availability of some key components and the evolution of the detailed operational requirements were some of the prime reasons selecting an iterative development cycle model used for the program.

An extensive validation/verification stage has been planned to minimize risks. These include structural component tests; including full scale tests up to wing limit loading, landing gear drop tests and other qualification tests such as datalink, flight control, electrical power generation, brakes, fuel and propulsion systems etc. A special emphasis is given in the software development environment, flight dynamics simulators and system integration laboratory infrastructure.

Currenly two prototypes are being assembled and the system integration laboratory recently became functional. First taxi tests and subsequent flight tests are scheduled for summer 2010.

Preliminary studies have already been started to fulfill different mission needs.

Genetically Optimized Neural Network Systems (GONNS) Applications for Unmanned Vehicles

Ibrahim N. Tansel, Gurjiwan Singh,
Gurjashan Singh, Srikanth Korla, Ming Li
Mechanical and Materials Engineering Department
Florida International University
Miami, FL 33174

Balemir Uragun
Turkish Aerospace Industries, Inc
Kazan-Ankara Turkey

Mustafa Demetgul
Marmara University, Technical Education Faculty
Goztepe, Istanbul, Turkey

ABSTRACT

Unmanned vehicles are generally designed by small teams in very short time. This approach keeps the cost low and let them to be adapted to developing new conditions. Many of the future unmanned vehicles will work at either unknown environments or need to operate very long time. They will need to collect data about their environments and operate by considering this information. Use of genetically optimized neural network systems (GONNS) is proposed for selection of initial design parameters and management of autonomous operation at unknown environments after proper information is collected.
Selection of the initial design parameters of the UAVs by using the GONNS is presented in the paper according to the mission characteristics. The relationship between the two input parameters (length and wing span) and one output were represented with three backpropagation type neural networks. The outputs were speed, endurance, and payload. GONNS allowed the user to optimize one of the parameters while the other two were kept at the desired range.
The study demonstrated GONNS may be used for the design optimization based on the experimental data requiring neither analytical nor empirical models. This approach may be extended to the management of the operations of the autonomous vehicles at unknown environments since the optimal operational parameters could be calculated after the artificial neural networks (ANN) of the GONNS are trained with the data collected during the mission.

Keywords: Unmanned vehicles, artificial neural network, backpropagation, autonomous operation, autonomous vehicles.

Reliability Analysis Process in UAS Development Programs

Anıl DEMİREL
TAI-Turkish Aerospace Industry
andemirel@tai.com.tr
Phone: +90 312 811 1800/7427
Fethiye Mah. Havacılık Bulv. No: 17
Kazan /Ankara/ Turkey

Ebru Nihal ÇETİN
TAI-Turkish Aerospace Industry
encetin@tai.com.tr
Phone: +90 312 811 1800/7363
Fethiye Mah. Havacılık Bulv. No: 17
Kazan /Ankara/ Turkey

ABSTRACT

Reliability is at the core of reducing acquisition cost, and improving mission effectiveness for Unmanned Aircraft Systems. This paper highlights, reliability analysis processes implemented during the design phase of a Middle Altitude Long Endurance Unmanned Air Vehicle that included the Failure Mode and Effect Analysis, Reliability Modeling, Fault Detection and Fault Isolation techniques. Short information and basic sample about these processes were given in this paper. In addition, the definitions of the terminology that were used in reliability studies were presented. The standards, software programs and sources used for reliability analysis were also mentioned. The difficulties that occur during the reliability analysis processes of Unmanned Air Vehicle were pointed out. This paper also included information about where and how the results of reliability analyses were used by the other design disciplines like safety and maintainability. The work presented here has profound implications for reliability studies of Unmanned Air Vehicle.

Keywords: Reliability, UAS, FMEA

An Automatic System to Detect Thermal Leakages on Building Facade Using Thermal Images

Dr. Beril Sirmacek, PhD
Research AssistantYeditepe UniversityDepartment of
Electrical and Electronics Engineering 34755
Kayisdagi - Istanbul / TurkeyPhone: +90 216 578 17 40
E-mail:bsirmacek@yeditepe.edu.tr
Web: http://ee.yeditepe.edu.tr/staff/beril

ABSTRACT

In recent years, very high energy consumption is the major problem of the big cities. Most of the energy of the cities are disbursed to warm and cool buildings. Thus, detecting heat leakages on building walls is a new research problem. In this study, we propose a novel system to detect thermal leakages automatically from thermal camera images. To this end, we use sequential thermal images of buildings. First, we start with fusing thermal image sequences to obtain rectified building facade with higher resolution. Then, we detect L-shaped features using a set of steerable filters. We use L-shaped features and perceptual organization rules to detect windows and doors from rectified thermal image. After eliminating detected doors and Windows from building facade, we detect problematic regions. One of the advantage of proposed system is that, it can also be used to detect building damages automatically even in night time. Therefore using proposed system, it may be possible to detect thermal leakages and also damages by only using images taken from a vehicle which is moving around interested buildings.

Investigation of Waveform Design for Range-Doppler Estimation Exploiting Cyclostationarity

Antonio Napolitano
Universita' di Napoli "Parthenope"
Dipartimento per le Tecnologie
Centro Direzionale di Napoli, Isola C4
80143, Napoli, Italy
Email: antonio.napolitano@uniparthenope.it

Kutluyil Dogancay
School of Electrical and Information Engineering
University of South Australia
Mawson Lakes, SA 5095, Australia
Email: kutluyil.dogancay@unisa.edu.au

ABSTRACT

The problem of waveform selection for range-Doppler estimation is addressed. The transmitted signal is assumed to be cyclostationary and cyclostationarity properties are exploited for range-Doppler estimation in severe noise and interference environments. Simulation results are carried out to investigate the parameter selection for better stimation performance.

Integer Linear Programming Based Mission Planning for UAVs

Ozcan Ozturk
Computer Engineering Department
Bilkent University

Can U. Hantas
Computer Engineering Department
Bilkent University

ABSTRACT

Mission Planning System (MPS) is a critical component in Unmanned Aerial Vehicles (UAVs) which enables these vehicles to operate efficiently and effectively. One key observation about UAVs is that these vehicles are scarce with different capabilities and functions. Our goal in this paper is to provide an integer linear programming based (ILP) mission planning system. Specifically, we try to optimally assign the available set of UAVs according to their given properties such as available sensors, fuel capacity, antennas, and transmitters.

Mission Planning Systems take the mission as an input and generate the planned mission as an output. In our implementation, a mission is represented by a directed task graph. More specifically, a mission can be represented by a node-weighted and edge-weighted directed acyclic graph (DAG), in which the node weights represent task processing times and the edge weights represent data dependencies as well as the communication times between tasks. Directed acyclic graphs (DAG) have been widely used in task scheduling, where allocation of the tasks and arrangement of execution sequencing of the tasks is the main goal. The objective of DAG scheduling is usually to minimize the overall execution latency, which is an NP-complete problem [Garey and Johnson 1979]. However, there are simple cases in which a polynomial-time solution exists [Coffman 1976].

As indicated above, we represent each task in a mission as a node in the task graph and we try to assign available UAVs to these tasks using ILP. We use a 0-1 variable to represent these mappings which indicates whether a given UAV, ai is being used to fulfill the task tj. More specifically, if xi,j = 1, then task tj is scheduled to be performed by ai. However, this ILP formulation requires many constraints to fully capture the problem. For example, it is usually the case that UAVs exhibit different characteristics. Therefore, it is necessary to assign a suitable UAV to each task.

Keywords: UAV, ILP, mission, planning, optimization.

Design Process of Anatolian Eagle

Sinan METİN, Ali BAŞAR, Serhat GÖKALP, Ali KARANLIK, Serkan AKGÜL,
Mansur ÇELEBİ, Zafer KAZANCI, Abdurrahman HACIOĞLU
Turkish Air Force Academy, Yeşilyurt, 34149, İstanbul, Turkey
3130metin@harbiyeli.hho.edu.tr, basar3128@ harbiyeli.hho.edu.tr,
3106gokalp@harbiyeli.hho.edu.tr, karanlik3312@harbiyeli.hho.edu.tr, a.akgul@hho.edu.tr,
m.celebi@hho.edu.tr, z.kazanci@hho.edu.tr, hacioglu@hho.edu.tr

ABSTRACT

This study describes the design process used by the Turkish Air Force Academy Anatolian Eagle Team to develop an unmanned aircraft capable of winning the 2010 AIAA Student Design/Build/Fly Competition. The goal of the design was to maximize the total competition score, which is a combination of the report score and three flight mission scores which make up the flight score.

Design development begins with an analysis of the scoring function that comprises of a report and a flight score (FS). The FS is based on three sequential flight missions: a ferry flight, and two three-lap payload flights. Mission one, which has a maximum score of 50, requires a fast aircraft and a low system weight. The three-lap softball payload missions will have a random selection of 6 to 10 softballs with a random circumference of 11" and 12" in which the loading time is the key factor. And the last mission is about carrying the maximum number of bats within the shortest time. To gain a score in any of these three missions, the aircraft must take-off in 100ft distance and perform a safe landing. To meet all these requirements an optimum configuration must be achieved. The internal and the external payloads were the main key subjects in designing the fuselage. The overall system configuration consists of a mid-mounted mono-wing airplane attached to a sleek fuselage, a conventional tail connected with a boom to the fuselage, a tractor motor and a tricycle landing gear all within a rectangular reverse-opening lid box. The design, while very traditional in appearance, contains several unique and innovative qualities which allow it to perform for a maximum score.

Having selected a design, the team was divided into specialized groups to execute the preliminary design phase. The aerodynamics, propulsion, drawing and structures teams were formed to analyze the selected configuration. This phase optimized independent sub-systems and the final integrated system design.

Keywords: Design process, preliminary design, optimization

Optimal Path-finding Algorithm for Autonomous Unmanned Ground Vehicles

Petr Stodola
University of Defence
Department of Military Management and Tactics
Petr.Stodola@unob.cz
Kounicova 65, Brno, Czech Republic

Jan Mazal
University of Defence
Department of Military
Management and Tactics
Jan.Mazal@unob.cz
Kounicova 65, Brno, Czech Republic

ABSTRACT

This paper deals with the optimal path-finding algorithm in a real general environment. This algorithm is designed for automatic motion of unmanned ground vehicles.
The article is the result of the long-term research in the area of unmanned aerial and ground vehicles at the University of Defence in the Czech Republic. University of Defence (within its research activities) also participates in the automation of decision processes, optimization of tactical tasks, etc.
The article is divided into the three basic parts. The first part presents a general discussion of the problem; the second part deals with the definition of basic principles of our algorithm; the last part presents the mathematical design for computing the exact position of the vehicle during its motion.
The algorithm has been verified not only on our software simulator, which can very authentically imitate all aspects of the laser scanning process and surrounding area reconstruction, but also in real conditions when the real laser scanning device has been used.
The article partially deals also with possibilities of our algorithm implementation. The optimal path-finding algorithm works in the parallel mode and is implemented on a graphical processor. This enables searching for an optimal path within a network with several million nodes in real time.
In conclusion of our article, we concern briefly with the unmanned ground vehicle which we are working on within the frame of our research at the University of Defence in Brno.

Keywords: unmanned vehicle, autonomous motion, path-finding algorithm, laser scanning process, area reconstruction, decision process automation

Structural Changes in Future Military Operations And Human Factors Concerning Manned and Unmanned Systems

Coskun Kurkcu
Air War College,
coskunkurkcu@yahoo.com
War Colleges, Yenilevent, Besiktas,
Istanbul 34340, TURKEY

Haluk Erhan
Air War College,
herhan@harpak.edu.tr
War Colleges, Yenilevent, Besiktas,
Istanbul 34340, TURKEY

ABSTRACT

Unmanned Aerial Vehicles (UAVs) play increasingly important roles in many modern militaries. The proven success of the UAVs during the operations in Afghanistan and Iraq has created a demand for UAVs with varying functionalities and capabilities. UAVs are currently performing tasks and playing roles of the manned systems in many mission areas. Although UAVs are limited in meeting all the requirements' parameters when compared to the manned systems, their low risk, low cost attributes and critical mission capabilities make them preferable. However, to what extent the UAVs can continue defining tomorrow's military missions is not predictable. There are some skepticism and hesitation about operating UAVs with minimal human oversight and how it influences the operational effectiveness when the limitations of autonomy or constant control needs are accounted. Therefore, it becomes crucially important to find out and apply the best matching between systems and missions considering the type of the mission and capabilities of UAVs. The emerging challenge is to identify the place of the UAVs in operational structures and versatile mission requirements, and possibly provide an integrative solution where both manned and unmanned systems collaborate in achieving given missions in the future of warfare.

The aim of this paper is to compare cognitive capabilities of UAVs and manned systems, and evaluate them in the context of anticipated future operating environment. The evaluation will focus on the efficiency of systems on the cognitive domain of information environment and impact on specific missions. The research is expected to contribute to a more informed structural transformation of the modern militaries.

Keywords: unmanned aerial vehicle, UAV, unmanned systems, manned systems, human factors, cognitive skills, decision making, critical thinking.

Development of a Proton Exchange Membrane Hydrogen Fuel Cell Stack for Unmanned Underwater Vehicles

Oğuzhan KATLI
GATE Elektronik A.Ş.,
oguzhan.katli@gateelektronik.com.tr
İstanbul Yolu 16. km No:1-A
Ergazi Yenimahalle,
Ankara/Türkiye

Özgür YILDIZ,
İbrahim GÖKALP, Bülent GÖKALP
TR Teknoloji Ltd., {ozgur.yildiz,
ibrahim.gokalp,bulent.gokalp}@gateelektronik.com.tr
Cyberplaza A Blok No: 702 Bilkent,
Ankara/Türkiye

A. Egemen YILMAZ
Ankara Üniversitesi
Elektronik Müh. Bölümü,
aeyilmaz@eng.ankara.edu.tr Tandoğan Kampüsü
06100 Ankara/Türkiye

ABSTRACT

In this paper, we present a study on performance of a prototype PEM hydrogen fuel cell system. Fuel cells have great expectations for supplying clean power especially in aviation, space and marine technology, where energy is the major key issue. Power performance of fuel cells are quitely depends on the flow channels formation and operational conditions. Thus the study is mainly focused on the stack and the ambient temperatures. System is aimed to be compact, durable, efficient and used in unmanned underwater vehicles.

Keywords: Proton exchange membrane, fuel cell, unmanned underwater vehicles.

Unmanned Aerial Vehicles Market in Aviation Industry and the Role of Integration

Ali BAŞ
1st Lt. (TuAF)
Air War College
alibas01@yahoo.com

Barbaros AKÇA
Maj. (TuAF)
Air War College

Erhan GAZİOĞLU
Maj. (TuAF)
Air War College

Hüseyin ERGEZEN
Lt. Col. (TuAF)
Air War College

ABSTRACT

Military power innovations especially unmanned systems caused a catastrophic change into warfare so as into defense technologies. The perception of combat will evolve into a new form with this change. The alluring transformation of combat area also made the market of Unmanned Aerial Vehicles (UAVs) attractive for Defense Industry actors.

Literally the portion of UAV projects in the aviation market is increasing almost in every country, region or organization. Even civilian initiatives are enthusiastic about the UAV systems. For example; in USA, the secretary of defense has identified 49 goals for unmanned aviation in order to support the department's overall strategy. In parallel with these strategies, funding for UAV development has risen from just above $ 3 billion in 1990's to over $ 12 billion for 2004 through 2009. US military forces plan to spend nearly $ 5,4 billion in 2010 on unmanned vehicle technology. This means an increase of 18.4 percent over 2009 military unmanned vehicle spending of $ 4.53 billion. UAV market should be evaluated in another market as payload market also. There are lots of opportunities in potential payload developments as well. The operability range of UAVs is proportional with its payload capability. So, the market's areas of interest are wide and comprehensive. Other than governmental institutions, lead aerospace manufacturers like Lockheed Martin, Northrop Grumann, Dassault, EADS Germany, Alenia Aerospazio, EADS Spain, SAAB, BAE systems, Thales and many other companies are competing on UAV projects and R&D efforts. To forecast a UAV market, which is dominant in aviation industry is not so hard.

Another issue of UAV market is the effect on Defense Industry Integrations through functionalist approach. The structure and specifications of this new market will be different on some key parameters from conventional aviation markets. When the markets are compared, certain differences will be observed and the integration approaches of the stakeholders ought to be different also. These integrations can be in different areas like technology transfer, manufacturing, R&D, resource management or marketing. A functionalist approach for UAV integrations may cause a less manageable condition in the terms of international relations. For example; the barriers of the UAV market are easier to reduce than the manned systems market.

In recent years, European countries signed agreements on collective UAV projects, and EU developments are being watched by US companies, Russia, India, Turkey buys UAVs from Israel. There are lots of integrations ongoing and lots of opportunities for the countries

in theatre.

The aim of this paper can be classified under two titles. One of them is to define potential size of UAV market in aviation industry. The second one is to identify the key specifications of UAV market that will affect the integration of Defense Industries and to forecast new structures of cooperation integrations on UAV projects. And also the spill-over factors of the UAV centered defense integrations will be examined.

MAV Conceptual Design Challenges with Software Project Management Aspect of the MCDA Tool

Mustafa Turan
Turkish Air War College
mustafaturan2002tr@yahoo.com
Hava Harp Akademisi,
Yenilevent, Beşiktaş,
İstanbul, 34330, Türkiye

Abdülkerim Ergüner
Turkish Air War College
k_erguner@yahoo.com
Hava Harp Akademisi,
Yenilevent, Beşiktaş,
İstanbul, 34330, Türkiye

Bayali Gezer
Turkish Air War College
Hava Harp Akademisi,
Yenilevent, Beşiktaş,
İstanbul, 34330, Türkiye

Ali O. Tolluoğlu
Turkish Air War College
Hava Harp Akademisi,
Yenilevent, Beşiktaş,
İstanbul, 34330, Türkiye

ABSTRACT

Micro Air Vehicles (MAV) are a subset of Unmanned Aircraft Systems (UASs) that are up to two orders of magnitude smaller than manned systems. Near-Earth environments, such as forests, caves, tunnels and urban structures make reconnaissance, surveillance and search-and-rescue missions difficult and dangerous to accomplish. Therefore, MAVs are considered ideal for these types of missions. Several universities have been involved in MAV research. It requires different disciplines to design a MAV, like any other vehicle, but the number of constraints is increasing due to the small scale of MAVs.

The current research mainly focused on a multidisciplinary approach to fixed-wing MAVs in a very suitable integration environment, called ModelCenter (MC). It was intended to have a tool for quick data evaluation in the conceptual design phase of a MAV project. Next step on the current effort, would be extending the capabilities of the created tool for generic rotary systems (such as multi-rotor, helicopter, or even monocopter) and flapping wing systems (bird-like or ornitopter type). Initially, a tool, fixed-wing MAV Conceptual Design and Analysis (MCDA), was created. A single-propeller and a coaxial MAV were evaluated with the MCDA tool. DATCOM, supplemented with limited experimental data, Drela's QPROP, Athena Vortex Lattice (AVL) were integrated into the model but not with its entire capabilities. MATLAB, Microsoft Excel and Phoenix Integration MC as the executive control program constituted the remaining parts of the MCDA. Data validation of the tool was made by comparing similar research on a fixed-wing MAV to the MCDA tool outputs with promising results.

The aim of this paper is to present the current capabilities of the MCDA multidisciplinary tool as well as challenges associated with development of the tool. Additionally, it will include the evaluation of the MCDA conceptual design approach through the project management best practices and standards as well as deriving results for similar conceptual design studies on similar platforms for Air Force needs and the cooperative defense integrations.

Keywords: ModelCenter, DATCOM, QPROP, AVL, MAV, integration, conceptual

Hyperspectral Data Classification Using Contourlet Transform

Bedrettin Erbil Konuk
Dept. of Satellite Communications and Remote Sensing, Istanbul Technical University
ekonuk@itu.edu.tr

Özgür Gültekin
Dept. of Electronics and Communication Engineering, Istanbul Technical University
gultekino@itu.edu.tr

Işın Erer
Dept. of Electronics and Communication Engineering, Istanbul Technical University
ierer@itu.edu.tr

ABSTRACT

The Contourlet Transform is a new technique to achieve a scale-invariant and directional signal analysis. This work discusses the Contourlet Transform and demonstrates its performance by classifying the AVIRIS Indiana's Indian Pine 1992 hyperspectral data set and comparing the results with the Wavelet Transform counterpart.

Comparison of Safety Concept in Unmanned Air Platforms versus Manned Air Platforms

Alper, PAHSA
HAVELSAN A.Ş. ODTÜ Teknokent
ARGE Binası, Ankara
apahsa@havelsan.com.tr

Gökçen, ALAT
HAVELSAN A.Ş. ODTÜ Teknokent
ARGE Binası, Ankara
galat@havelsan.com.tr

ABSTRACT

Today there is an increasing interest in the use of Unmanned Air Platforms (UAPs) in world wide military applications. Especially UAPs used with various specialized payloads in many forms of command, control, communication, reconnaissance, intelligence and surveillance missions. Starting from the UAPs design to the prototype production, various pros and cons are introduced. The aspects subject to discussion in this paper are challenging safety considerations. UAPs safety assurance derives a different perspective other than the safety assurance in air platforms with manned. Safety considerations related to UAPs are comparatively more crucial than the air platforms with manned due to the absence of an operator within the flying platform. In many applications of air platforms with manned, various world wide accepted military and civilian standards are used for safety assurance. Safety assurance standards used in UAPs are specialized in many areas based on the application. Many civilian aviation certification audit authorities still do not certify the safety assurance of UAPs because many UAPs applications are still accepted as remote controlled airborne toy derivative platforms. However, some of the military UAPs applications are excluded from this situation. Many aviation certification authorities still require the UAPs to fly in a safe altitude in order to increase the safety assurance of air platforms with manned. On the contrary, many forms of system safety assurance criteria are formed for UAPs by the many UAP technical workgroups in the world. The developed criteria set are so strict for the UAPs such that the application of safety assurance criteria is more difficult than that of the air platforms with manned. In this study, system safety assessment of UAPs is compared with the air platforms with manned from the perspective of system engineering applications.

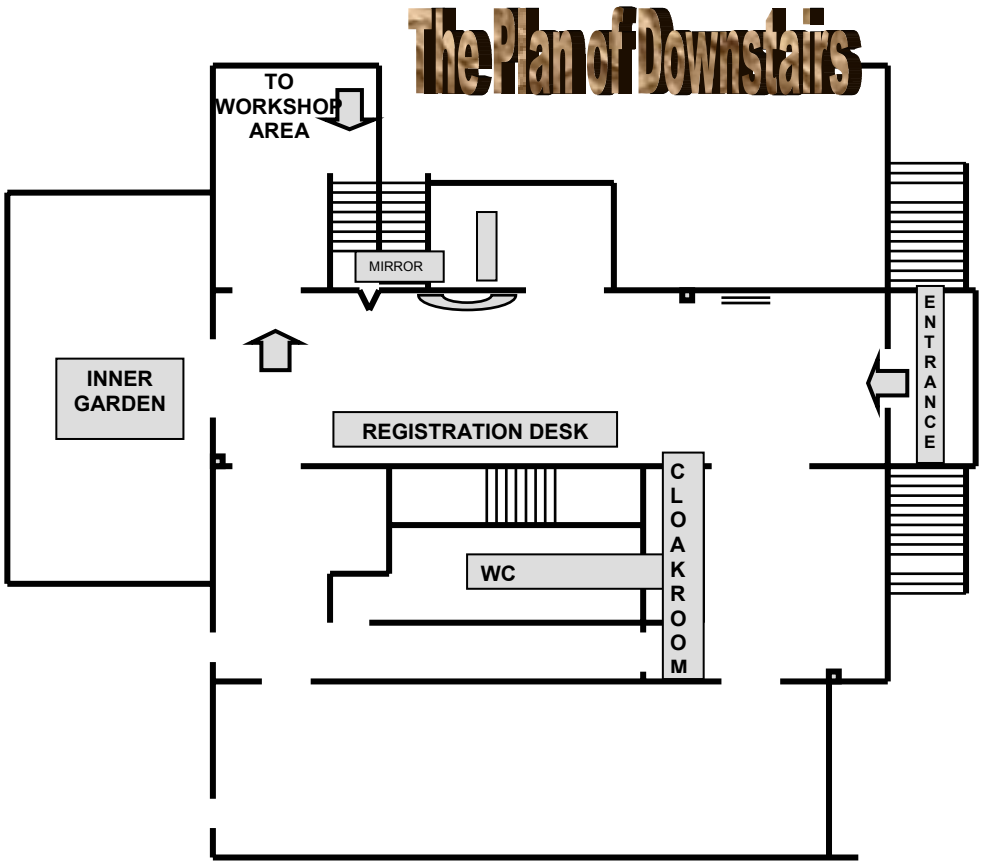
WORKSHOP VENUE

The workshop will be held at Harbiye Military Museum and Cultural Center which is located in downtown Istanbul.

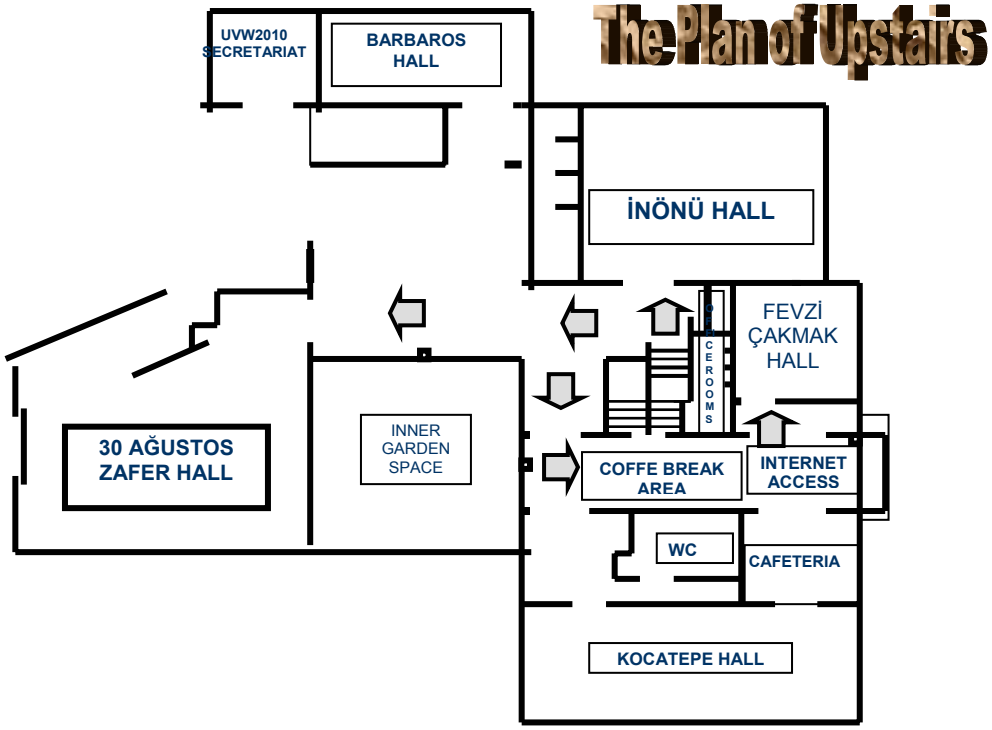
Satellite Image of the Workshop Area:

Harbiye Military Museum and Cultural Center:

BUILDING PLANS



BUILDING PLANS



PROGRAM OF EVENTS

DATE	EVENT	TIME AND PLACE
10 June 2010	Welcome Cocktail	19:00 Harbiye Turkish Officers' Club
11 June 2010	Workshop Dinner	20:00 Harbiye Turkish Officers' Club
Notice: Lunches will be served at Harbiye Turkish Officers' Club		

ADMINISTRATIVE GUIDE

1. Security:

a. Overnight custody of the classified documents will be each Delegate's responsibility.
b. All Delegates are encouraged to carry UVW2010 or national ID cards. Workshop passes were issued during in processing and are to be worn in the Workshop facilities.

2. Dress Code:

a. Formal clothes will be worn in all formal meetings.
b. Casuals are appropriate for all social activities except the Welcome Cocktail and Workshop Dinner.

3. Transportation:

a. Bus transportation will be provided for the social activities. The schedule is shown in the program of events.
b. Transfers from the hotel to the airport by Travel Organization Company (T.O.C.). If required, ask for details of transfers at the T.O.C. desk.

4. Social Events:

a. Social events are listed in the program of events.

5.Health:

a. In case of a serious health problem, participants are encouraged to inform the Turkish Delegates and T.O.C. representatives.
b. The organization committee is not responsible for the attendee's insurance.

6. Communications:

a. Secure Communication is not available during the workshop.
b. All telephone calls should be made from individual hotel rooms and will be detailed on the hotel invoice for payment at out-processing. It is the individual's responsibility to reclaim the cost of duty calls from their appropriate authority/HQ on their return. Turkish Air Force Academy is not responsible for any telephone calls made by attendees at the workshop. Internet connection, a PC, and a printer will be provided for the use of attendees. Public phones are available at the conference area.

7. Miscellaneous:

a. Out-processing will take place at two locations, the T.O.C. desk and the hotel reception.
b. At the T.O.C. desk you will receive 2 vouchers:
   Voucher 1 is for accommodation. This is the voucher you completed during in processing and is provided for you to check and sign before it is presented for payment.
   Voucher 2 is for other expenses incurred such as participation in the Dinner and other arranged social activities.
   These vouchers will be prepared in EURO (or USD upon request). The amount will be converted to Turkish Lira at the bank exchange rate of the day. Payment can be made in cash (USD, EURO or TL). Payment by credit cards will be charged in TL.
   The clearance of the vouchers above 24 hours before your departure will make out-processing easier.
   At the hotel reception you will receive Voucher 3 which covers all the expenditures e.g. telephone, mini-bar, room service, bar, restaurant etc. Which you have charged to your room during your stay. This voucher will be presented for payment in TL.
c. For payments to T.O.C. major credit cards are accepted.
d. Departure from the Hotel to Istanbul International Airport is usually very early in the morning. Your options are to make your own arrangements or to take advantage of the Transfer arrangement offered by T.O.C. Please inform of your transfer request to T.O.C. 24 hours before your planned departure.

USEFUL TELEPHONE NUMBERS

Harbiye Military Museum	:+90 212-2332720
UVW2010 Secretariat	:+90 212-6632490/4365
Police	:155
International Hospital	:+90 212- 663 30 00
American Hospital	:+90 212- 231 40 50
German Hospital	:+90 212- 293 21 50
Rental Cars	:T.O.C. (Travel Organization Company-T.O.C.)
Airlines	:T.O.C. (Travel Organization Company-T.O.C.)
Mrs.Esra Gucuyener (T.O.C.)	:+90 533-370 02 82 (GSM)
Mr. Ferdi AKBAŞ (T.O.C.)	:+90 533-779 67 51(GSM)
Sgt.Samet GOKBULUT UVW2010 Secreteriat	:+90 0506-91014 63 (GSM)

CONSULATES

AZERBAJIAN
Ph.:212 293 21 23

AUSTRALIA
Ph:212 243 13 33

BELGIUM
Ph:212 243 33 00

BULGARIA
Ph.: 212 269 04 78

CZECH REPUBLİC
Ph: 212 230 95 97

GREECE
Ph: 212 245 05 96

ITALY
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Ph:312 491 91 00

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Ph.:212 292 41 25

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