2019 INTERNATIONAL CONFERENCE ON UNMANNED AIRCRAFT SYSTEMS

ICUAS'19

June 11-14, 2019

Atlanta Marriott Buckhead Hotel & Conference Center
3405 Lenox Road NE, Atlanta, Georgia 30326

FINAL PROGRAM

Technical Sponsorship Organizations

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Welcome Message from the ICUAS Association

Dear participants and attendees:
On behalf of the ICUAS Association Inc., and in my capacity as President, it is a great pleasure and honor to welcome you to ICUAS’19. The ICUAS Association is a non-profit organization. Its vision is threefold: i) Establish the annually organized and fully sponsored ICUAS as the flagship technical conference in unmanned aerial vehicles, both nationally and internationally, eventually expanding conference objectives to include all types of unmanned systems; ii) Through the Association’s activities and initiatives, contribute to pushing forward the frontiers of unmanned systems leading to the next generation of fully autonomous and fully functional prototypes, and, iii) Contribute to educating students, researchers, scientists, engineers and practitioners, as well as the general public, about unmanned systems.

The mission of the Association is to advance knowledge, education, basic and applied research and development in unmanned systems by: Organizing annual conferences, workshops, tutorials and other technical meetings in unmanned systems in general, and in Unmanned Aircraft Systems in particular; Offering short courses and other technical courses in unmanned systems to scientists, engineers, researchers and practitioners who are interested in learning and/or improving their knowledge in this area; Publishing annually the ICUAS proceedings; Publishing on an ‘as needed basis’ highly technical research monographs and textbooks in topics of interest in unmanned systems.

Our goals are to: Benefit researchers, scientists, engineers and practitioners; Advance the state-of-the-art in unmanned systems; Contribute to developing the next generation of unmanned systems; Contribute to the advancement of higher education; Educate the public about how unmanned systems may be used in a wide spectrum of civilian and public domain applications like search and rescue, emergency response, early fire detection and forest protection, environmental monitoring, to name but a few applications.

We are looking forward to your involvement, contributions and feedback. We welcome your participation and we are open to your ideas and suggestions to register the ICUAS Association as the primary organization that: Benefits students, researchers, scientists, engineers, practitioners and end-users; Advances the state-of-the-art in UAS; Contributes to the advancement of higher education.

My best wishes for a successful and productive conference, and I look forward to seeing you in Atlanta.

Kimon P. Valavanis

Welcome Message from the General Chairs

Dear participants and attendees:
On behalf of the 2019 ICUAS Organizing Committee, it is a privilege and a pleasure to welcome you to this year’s conference, on June 11-14, 2019. The three-day Conference is preceded by a one-day Workshops / Tutorials program, on Tuesday, June 11. We are certain you will be very pleased with the conference venue, and you will enjoy all the attractions Atlanta offers.

Conference participants represent academia, industry, government agencies, lawyers, policy makers, manufacturers, students and end-users, all having deep interest in the state-of-the-art and future directions in unmanned aircraft systems. We received 237 contributed/invited session papers. This is the second highest number since launching ICUAS. Following a very thorough and in-depth peer review process in which each paper had at least four reviews (three external reviewers plus a member of the organizing committee), and in some cases as many as eight, roughly 77% of contributed, invited session and poster papers were accepted. All papers were also checked following the iThenticate Document Viewer Guide receiving a ‘similarity score’ and a ‘max percentage match’ before final decision was made. We have assembled a full three-day top-quality Technical Program. We also have three Plenary Lectures in which the keynote speakers address pressing and important issues related to unmanned aviation in civil and restricted airspace.

The Organizing Committee members have devoted an enormous amount of time and effort to make sure...
that the conference is exciting, informative and educational. We are privileged and honored to have worked with all the members and we are truly indebted to everyone for their dedication and professionalism. We also extend a wholehearted “thank you” to all reviewers, Associate Editors and members of the Technical Program Committees; their help was integral to assembling a top-quality Technical Program. The peer review process was coordinated by the Program Chairs and Co-Chairs. Dr. Pradeep Misra was the essential “glue” that kept everything together, since all papers were submitted through https://controls.papercept.net. We wouldn’t have been able to complete the paper review process without his help.

We thank you for your participation and contributions. We hope you enjoy the conference, as well as Atlanta and the other surrounding areas.

Didier Theilliol and Yang-Zuan Chen

Welcome Message from the Program Chairs

Dear participants and attendees:
Welcome to ICUAS’19. This year we received 237 contributed, invited session full-length papers and poster papers. This number is the second highest compared to any previous ICUAS. The paper review process has been extremely thorough and rigorous. All papers were also checked for originality using the IThenticate Document Viewer Guide. Our initial goal was for each paper to have at least three reviews. We exceeded this goal; each paper had on average more than 3 reviews and some papers had as many as 8 reviews! However, considering that the Program Chairs and other members of the Organizing Committee coordinated all paper reviews and read all papers, each paper received an average of more than 4 reviews.


The review process resulted in accepting 188 contributed, invited and poster session papers. The technical program spans three days, during which all accepted, and poster papers will be presented. Submitted/accepted papers are from the following countries (listed in ascending order of submissions): USA, Mexico, Brazil, India, Canada, France, Spain, China, Italy, Norway, Singapore, South Korea, Denmark, Germany, Portugal, Hungary, Japan, Australia, United Kingdom, Argentina, Croatia, Cyprus, New Zealand, Pakistan, Paraguay, Poland, Qatar, South Africa, Switzerland, Taiwan, United Arab Emirates.

We would like to thank all the authors for their contributions. Our rigorous review process would not have been possible if we did not have such a strong community of expert reviewers in unmanned aircraft systems. We thank all reviewers for their professional service.

Pradeep Misra helped us in working and using effectively the on-line paper submission and review system. He has been very responsive and helpful in issues related to the system. Our questions were mostly due to our novice and inexperience with the on-line system. We acknowledge that this on-line system is very sophisticated and yet very practical to use for both small and large-scale conferences. It is very hard to imagine how things would have been done without this excellent on-line system!

We hope you enjoy not only the technical aspects of the conference but also beautiful Atlanta. Fly high and safe, to the next ICUAS!

James Morrison and Antonios Tsourdos
ICUAS’19 Tutorials and Workshops

ICUAS’19 offers three pre-conference Workshops/Tutorials addressing current and future topics in unmanned aircraft systems from experts in academia, national laboratories, and industry. Interested participants may find details on the Conference web, www.uasconferences.com, and they may use the online system for registration.

All Tutorials / Workshops will take place on Tuesday, June 11, 2019. See the attached map for the location of the rooms. Tutorial/Workshop duration is either Full-Day (9:00 AM – 5:30 PM) or Half-Day (09:00 AM – 01:00 PM).

<table>
<thead>
<tr>
<th>Location</th>
<th>Time</th>
<th>Title</th>
<th>Organizers</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 Heritage A</td>
<td>Full-Day 9:00 AM–5:30 PM</td>
<td>NEW DEVELOPMENTS ON SENSE-AND-AVOID (S&amp;A), FAULT-TOLERANT CONTROL (FTC) AND FAULT-TOLERANT COOPERATIVE CONTROL (FTCC) TECHNIQUES FOR UNMANNED SYSTEMS AND THEIR APPLICATIONS</td>
<td>Drs. Youmin Zhang and Didier Theilliol</td>
</tr>
<tr>
<td>T2 Heritage B</td>
<td>Half-Day 9:00 AM-1:00 PM</td>
<td>TOWARDS NETWORKED AIRBORNE COMPUTING: APPLICATIONS, CHALLENGES, AND ENABLING TECHNOLOGIES</td>
<td>Drs. Yan Wan, Kejie Lu, Shengli Fu, Junfei Xie</td>
</tr>
<tr>
<td>T3 Heritage C</td>
<td>Half-Day 9:00 AM-1:00 PM</td>
<td>UAV HEALTH MANAGEMENT ISSUES: CAN SMALL UAVS SURVIVE EXTREME DISTURBANCE ENVIRONMENTS?</td>
<td>Drs. George J. Vachtsevanos and Kimon P. Valavanis</td>
</tr>
</tbody>
</table>

ICUAS’19 Plenary Lectures

ICUAS’19 includes three Keynote / Plenary Lectures given by leading authorities in their respective fields. We are honored to include their talks as part of this year’s Conference program. All Plenary/Keynote lectures will be in the General Session Room, Heritage B. There will be two Plenary/Keynote lectures on Wednesday, June 12, and one on Thursday, June 13. The schedule for the lectures is shown next.

**WEDNESDAY – JUNE 12 – HERITAGE B**

**8:45 – 9:45 AM**

**LAW, LAWFARE AND TECH: AN ARGUMENT FOR COLLABORATION**

CHARLES J. DUNLAP (MAJ. GEN. USAF, RET.), Professor of the Practice of Law, Executive Director of the LENS Center on Law, Ethics & National Security, Duke Law School

**1:45 – 2:45 PM**

**THE 2018 FAA REAUTHORIZATION ACT – WHERE TO FROM HERE?**

JAMES O. POSS (MAJ. GEN. USAF, RET.), Chief Executive Officer, ISR Ideas

**THURSDAY - JUNE 13 – HERITAGE B**

**8:45 – 9:45 AM**

**THE INVASIONS OF DRONES - PUBLIC PERCEPTION AND SAFETY**

Dr. Brandon Stark, Center of Excellence for Unmanned Aircraft System Safety University of California - Merced
ICUAS’19 Information

The Venue
The Conference venue is the Atlanta Marriott Buckhead Hotel & Conference Center, located in the heart of Atlanta. There is a plethora of Local Attractions close to the venue, including: Lenox Square Mall; Phipps Plaza Mall; World of Coca Cola; Callanwolde Fine Arts Center; The King Center; Stone Mountain Park; Georgia Aquarium; College Football Hall of Fame; Underground Atlanta; North Georgia Premium Outlet Mall; Buckhead Shops and Restaurants; CNN Center; Georgia Governor's Mansion; High Museum of Art; Martin Luther King Jr Center; Six Flags Over Georgia; World Congress Center, and, Atlanta Zoo.

Travel Directions
The hotel does not provide shuttle services.

Hartsfield-Jackson Atlanta International Airport (ATL)
   Hotel direction: 17 miles N
   Estimated taxi fare: 40 USD (one way). Subway service, fee: 2.5 USD (one way)
   Driving directions: Take I-85 North to Exit #87 (Georgia 400), to Exit #2 (Lenox Road); Turn right and follow Lenox Road Signs, cross Peachtree Road. The Hotel is 1.5 blocks on the left.

Dekalb-Peachtree Airport (PDK)
   Hotel direction: 5 miles E
   Estimated taxi fare: 18 USD (one way). Subway service, fee: 2.5 USD (one way)
   Driving directions: Going South on Clairmont Road NE toward 9th Street, turn right at Dresden Drive NE, turn left at Peachtree Road NE, turn left at Lenox Road NE. The hotel is on the left side.

Conference Registration
All Conference attendees must register by using the on-line registration when they upload the final version of their papers. It is not required to upload a paper to register for the conference. Late and on-site registration is also available for non-authors who want to attend the conference. To register, follow the steps:

✓ Go to https://controls.papercept.net
✓ Scroll down the list until you find ICUAS 2019 - Choose ICUAS 2019 (from the list of conferences)
✓ Click on Register for ICUAS’19
✓ Login with your PIN and Password. First time users must create a 'profile', get a PIN and Password.
✓ After you Log in, choose Registree
✓ Follow the self-explained screens to register.

All registered participants must check in at the Registration Desk to pick up their registration packages. Personal badges will be provided to all registered participants. Attendees must wear their badges at all times when attending any ICUAS’19 event (technical sessions, exhibits, and social functions). This is very important for security reasons.
Registration will be in the **Heritage Prefunction** area. Registration hours will be open as follows:

**TUESDAY, JUNE 11:**
- **Workshop/Tutorial Registration ONLY** 8:00 AM – 11:00 AM
- **Conference Registration** 1:00 PM – 5:00 PM

**WEDNESDAY, JUNE 12:** 8:00 AM – 5:00 PM
**THURSDAY, JUNE 13:** 8:00 AM – 3:00 PM
**FRIDAY, JUNE 14:** 8:30 AM – 11:00 AM

**On-site conference registration policy and fees:** Attendees will be able to register for the Conference under the following registration categories/rates:

<table>
<thead>
<tr>
<th>ATTENDEES</th>
<th>ON-SITE REGISTRATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic, Industry, Government</td>
<td>$600</td>
</tr>
<tr>
<td>Legal and Policy Track (only)</td>
<td>$300</td>
</tr>
<tr>
<td>Student</td>
<td>$350</td>
</tr>
<tr>
<td>Workshop / Tutorials</td>
<td>$150 / $180</td>
</tr>
<tr>
<td>Extra Banquet Ticket</td>
<td>$100</td>
</tr>
<tr>
<td>Extra Proceedings</td>
<td>$40</td>
</tr>
</tbody>
</table>

**Meeting Area and Exhibits**
The meeting area is in the same floor, see attached floorplan. All activities, Registration, Workshops / Tutorials, Technical Sessions, Exhibits and Coffee Breaks will take place in one level, for the duration of the Conference.

- **Workshops/Tutorials** will be in: **Heritage A, Heritage B and Heritage C**.
- **The Legal and Policy Track** (Wednesday, June 13) will be in **Oglethorpe**.
- **Technical Sessions** will be in: **Heritage A, Heritage B, Heritage C**, and, **Savannah**.
**Internet Access**
All registered attendees will have complementary internet access in the meeting space area. Log in and Password information will be provided at the conference registration desk.

**Continental Breakfast and Coffee Breaks**
Continental Breakfast will be served in the morning, Wednesday to Friday, for all registered attendees, 7:45-8:30 AM. There will be two coffee breaks per day, one in the morning and one in the afternoon. Continental Breakfast and coffee breaks will be served in the Heritage Prefunction area.

**Events and Receptions**
The ICUAS’19 social agenda include:

- Welcome Reception, 7:00 PM: *Winning Edge* (Lobby Level)  
  Tuesday, June 11
- Gala Dinner: 7:30 PM *Buckhead Ballroom*  
  Thursday, June 13

**Conference Technical Sessions - Wednesday, June 12 – Friday, June 14**
In addition to the Plenary/Keynote lectures, there will be four parallel technical sessions each day. All Technical Sessions will be in Heritage A, Heritage B, Heritage C, and Savannah.

**Exhibits**
Exhibits will be in the Heritage Prefunction area to guarantee maximum traffic and exposure.

**Poster Papers**
Poster papers will be presented on Wednesday, June 12, in the Heritage Prefunction area.
**ICUAS’19 Legal and Policy Track Information**

**Location:** Oglethorpe  
**Wednesday, June 12**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
</table>
| **10:00 – 11:00 AM** | LAWYERING FOR DRONE CLIENTS IN THE U.S.: BASICS OF FEDERAL DRONE REGULATION, UTM, AND CORPORATE BEST PRACTICES  
M. A. SWANSON, Partner, Wilkinson, Barker, Knauer, LLP., Washington, D.C.  
M. BLANKS, Director, Virginia Tech Mid-Atlantic Aviation Partnership, Virginia Tech |
| **11:00 AM – 12:15 PM** | ROUND TABLE PANEL DISCUSSION: THE LEGAL, POLICY AND ETHICAL IMPLICATIONS OF AI  
**Moderator:** R. G. GROSS (Brig. Gen. USA, Ret.), Former Legal Counsel, Chair Joint Chiefs of Staff, Self-Employed Senior Counsel/Strategic Advisor, Knoxville  
**Panelists**  
L. R. BLANK, Clinical Professor of Law/Dir. Center for International and Comparative Law and International Humanitarian Law Clinic, Emory Univ. School of Law, Atlanta  
F. COPPERSMITH, CEO/Founder, Smarter Reality, Austin  
J. Z. MALEKOS SMITH, J.D., Reuben Everett Cyber Scholar, Duke Law, Center of Law & Technology/Center for Law, Ethics & National Security, Durham  
S. V. DAVIS, Lt Col, USAF, Chief, Air & Space Law Division, Operations & International Law Directorate, Headquarters Air Force, Office of The Judge Advocate General |
| **12:15 – 12:45 PM** | LUNCH |
| **12:45 – 1:45 PM** | SPECIAL CLE PROFESSIONAL WELLNESS SESSION  
SUPER LAWYERS: ETHICAL IMPLICATIONS OF STRESS, BURNOUT AND WELL-BEING  
C. W. PATTON, J.D., M.ED, ED.D., National Legal Education Speaker, Professor, Executive Well-Being Advisor, ChildAdvocateLaw.com, KY & ID  
J. W. PATTON, LL.M., M.DIV., Chief Legal Officer & Vice President for Advancement, The Broadhurst Group, KY & ID |
| **3:00 – 4:15 PM** | ROUND TABLE PANEL DISCUSSION: AN UPDATE ON INTERNATIONAL RPAS REGULATION  
**Moderator:** J. MARTIN, Esq., Associate General Counsel, Electric Power Research Institute (EPRI)  
**Panelists**  
A. KONERT, PhD, Dean, Faculty of Law and Administration and Law Professor, Director of Institute of Air & Space Law, Lazarski Univ., Warsaw, Poland  
P. KASPRZYK, PhD, Attorney at Law & Research Fellow, Institute of Air and Space Law, Lazarski Univ. Warsaw, Poland  
E. BASSI, PhD, Nexa Center for Internet & Society, Dept. of Control & Computer Engineering, Politecnico di Torino, Italy |
| **4:15 – 5:30 PM** | LEGAL JEOPARDY GAME SHOW LIGHTNING ROUND: CONTEMPORARY GLOBAL LEGAL & POLICY ISSUES IN DRONE OPERATIONS”  
**Moderator:** D. M. K. ZOLDI (Col USAF, Ret.), Associate General Counsel, U.S. Air Force Academy Business Matters, Office of Air Force General Counsel, CO & DC  
**Panelists**  
S. J. NILSSON, PhD, J.D., M.A.S., Assistant Professor of Aviation and UAS Law, Embry Riddle Aeronautical University, Prescott  
C. CHAN, Esq., Partner, Eversheds Sutherland (U.S.) LLP, Atlanta  
F. QUAGLIOTTI, Professor Ing., Department of Mechanical & Aerospace Engineering, Politecnico di Torino, Italy  
F. X. NOLAN IV, Esq., Counsel, Eversheds Sutherland (U.S.) LLP, New York |
| **SOCIAL HOUR 5:45PM – 7PM, CLE participants only** |
ICUAS’19 TECHNICAL PROGRAM AT A GLANCE

Wednesday, June 12

<table>
<thead>
<tr>
<th>Heritage B</th>
<th>Heritage A</th>
<th>Heritage C</th>
<th>Savannah</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:00-12:00 WeA1</td>
<td>10:00-12:00 WeA2</td>
<td>10:00-12:00 WeA3</td>
<td>10:00-12:00 WeA4</td>
</tr>
<tr>
<td>Path Planning I</td>
<td>Swarms I</td>
<td>Risk and Reliability</td>
<td>Control Architectures I</td>
</tr>
<tr>
<td>15:00-17:00 WeB1</td>
<td>15:00-17:00 WeB2</td>
<td>15:00-17:00 WeB3</td>
<td>15:00-17:00 WeB4</td>
</tr>
<tr>
<td>Path Planning II</td>
<td>Swarms II</td>
<td>UAS Applications I</td>
<td>Control Architectures II</td>
</tr>
<tr>
<td>17:00-19:00 WeC1</td>
<td>17:00-19:00 WeC2</td>
<td>17:00-19:00 WeC3</td>
<td>17:00-19:00 WeC4</td>
</tr>
<tr>
<td>Fault Diagnosis,</td>
<td>Fault Diagnosis, Accommodation &amp;</td>
<td>UAS Applications II</td>
<td>Control Architectures III</td>
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<td>See-and-Avoid Systems</td>
<td>Fault-Tolerant Control</td>
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</table>

Poster Papers WeP5: Heritage Prefunction – Exhibit and Presentation Timeframe: 13:00 – 18:00 PM

Coffee Breaks: 9:45 AM – 10:00 AM and 14:45 – 15:00 PM

Thursday, June 13

<table>
<thead>
<tr>
<th>Heritage B</th>
<th>Heritage A</th>
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<th>Savannah</th>
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<tbody>
<tr>
<td>10:00-12:00 ThA1</td>
<td>10:00-12:00 ThA2</td>
<td>10:00-12:00 ThA3</td>
<td>10:00-12:00 ThA4</td>
</tr>
<tr>
<td>Path Planning III</td>
<td>Micro and Mini UAS</td>
<td>UAS Applications III</td>
<td>Energy Efficient UAS</td>
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<tr>
<td>Path Planning IV</td>
<td>Sensor Fusion I</td>
<td>UAS Applications IV</td>
<td>Airspace Management</td>
</tr>
<tr>
<td>16:00-18:00 ThC1</td>
<td>16:00-18:00 ThC2</td>
<td>16:00-18:00 ThC3</td>
<td>16:00-18:00 ThC4</td>
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<tr>
<td>See-and-Avoid Systems</td>
<td>Sensor Fusion II</td>
<td>UAS Applications V</td>
<td>Airspace Control</td>
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</tbody>
</table>

18:00-19:00 PM: Heritage B - Round Table: - UAV Contributions and Challenges to Society
Chair: G. J. Vachtsevanos, Georgia Institute of Tech.

Coffee Breaks: 9:45 AM – 10:00 AM and 15:30 – 16:00 PM

Friday, June 14

<table>
<thead>
<tr>
<th>Heritage B</th>
<th>Heritage A</th>
<th>Heritage C</th>
<th>Savannah</th>
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<tbody>
<tr>
<td>9:00-11:00 FrA1</td>
<td>9:00-11:00 FrA2</td>
<td>9:00-11:00 FrA3</td>
<td>9:00-11:00 FrA4</td>
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<tr>
<td>UAS Design</td>
<td>Autonomy I</td>
<td>UAS Navigation I</td>
<td>Environmental Issues</td>
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<tr>
<td>Risk Analysis and</td>
<td>Autonomy II</td>
<td>UAS Navigation II</td>
<td>UAS Testbeds</td>
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<tr>
<td>Risk-Based Methods</td>
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<td>for UAS</td>
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Coffee Break: Continuous Coffee starting at 11:00 AM
# ICUAS’19 CONTENT LIST

**Technical Program for Wednesday June 12, 2019**

## WeA1 - Heritage B: Path Planning I

Chair: Sharma, Rajnikant  
Co-Chair: Rathinam, Sivakumar  
10:00-10:20  
**WeA1.1**  
*(77)* Onboard Generation of Optimal Flight Trajectory for Delivery of Fragile Packages  
Yuan, Weihong; Rodrigues, Luis  
10:20-10:40  
**WeA1.2**  
*(86)* Smooth Path Planning for Fixed-Wing Aircraft in 3D Environment Using a Layered Essential Visibility Graph  
D’Amato, Egidio; Notaro, Immacolata; Blasi, Luciano; Mattei, Massimiliano  
10:40-11:00  
**WeA1.3**  
*(112)* Hu-Moment-Based Autonomous Landing of a UAV on a Hemispherical Dome  
K, Ravi Chandra; Ghosh, Satadal  
11:00-11:20  
**WeA1.4**  
*(206)* Nonlinear Model Predictive Control to Aid Cooperative Localization  
Manoharan, Amith; Sharma, Rajnikant; Sujit, P. B  
11:20-11:40  
**WeA1.5**  
*(207)* Landmark Placement for Cooperative Localization and Routing of Unmanned Vehicles  
Wang, Bingyu; Rathinam, Sivakumar; Sharma, Rajnikant  
11:40-12:00  
**WeA1.6**  
*(211)* Encirclement of Moving Targets Using Relative Range and Bearing Measurements  
Jain, Puneet; Peterson, Cameron

## WeA2 - Heritage A: Swarms I

Chair: Pack, Daniel  
Co-Chair: Tsourdos, Antonios  
10:00-10:20  
**WeA2.1**  
*(21)* Software Defined Network Based Architecture to Improve Security in a Swarm of Drones  
Guerber, Christophe; Larrieu, Nicolas; Royer, Mickaël  
10:20-10:40  
**WeA2.2**  
*(22)* Efficient Decentralized Task Allocation for UAV Swarms in Multi-Target Surveillance Missions  
Li, Teng; Shin, Hyo-Sang; Tsourdos, Antonios  
10:40-11:00  
**WeA2.3**  
*(48)* Cooperative Target Tracking by Altering UAVs’ Linear and Angular Velocities  
Ma, Lili  
11:00-11:20  
**WeA2.4**  
*(83)* A Fast, Robust and Decentralized Approach for Altitude De-Confliction of Multiple UAVs  
Cao, Jiawei; Teo, Rodney; Huang, Sunan; Ren, Qinyuan  
11:20-11:40  
**WeA2.5**  
*(148)* A Hybrid Algorithm for Modifying and Tracking Connectivity in UAV Teams  
Trimble, James; Pack, Daniel; Ruble, Zachary  
11:40-12:00  
**WeA2.6**  
*(223)* UAVs Formation Control with Dynamic Compensation Using Neuro Adaptive SMC  
Rosales, Claudio Dario; Gimenez, Javier; Rossomando, Francisco; Soria, Carlos; Sarcinelli-Filho, Márcio; Carelli, Ricardo

## WeA3 - Heritage C: Risk & Reliability

Chair: Ciarletta, Laurent  
Co-Chair: Jensen, Kjeld  
10:00-10:20  
**WeA3.1**  
*(27)* Improving Redundancy and Safety of UTM by Leveraging Multiple UASs  
Schwalb, Edward; Schwalb, Joseph  
10:20-10:40  
**WeA3.2**  
*(28)* Monitor-Centric Mission Definition with Sophrosyne  
Viard, Louis; Ciarletta, Laurent; Moreau, Pierre-Etienne  
10:40-11:00  
**WeA3.3**
Game Theoretic Strategies for an Unmanned Aerial Vehicle Network Host under DDoS Attack
Aakif Mairaj, Subhrajit Majumder, Ahmad Y. Javaid
11:00-11:20  WeA3.4

A Methodology for Evaluating Commercial Off the Shelf Parachutes Designed for sUAS Failsafe Systems
Tofterup, Vincent Klyverts; Jensen, Kjeld
11:20-11:40  WeA3.5

Embedding Consequence Awareness in Unmanned Aerial Systems with Generative Adversarial Networks
Zhang, Guoxiang; Alcala, Jose; Ng, Jeffrey; Chen, Mighty; Wu, Xiangyu; Mueller, Mark Wilfried; Chen, Y.-Q.

WeA4 – Savannah: Control Architectures I
Chair: Sarcinelli-Filho, Mário  Co-Chair: Kuchwa-Dube
10:00-10:20  WeA4.1

Quadrotor-Based Aerial Manipulator Altitude and Attitude Tracking Using Adaptive Super-Twisting Sliding Mode Control
Kuchwa-Dube, Chioniso; Pedro, Jimoh Olarewaju
10:20-10:40  WeA4.2

Robust Control Architecture for Wind Rejection in Quadrotors
Verberne, Johannes; Moncayo, Hever
10:40-11:00  WeA4.3

Input Shaped Trajectory Generation and Controller Design for a Quadrotor-Slung Load System
Fielding, Sean; Nahon, Meyer
11:00-11:20  WeA4.4

Adaptive Control for a Tilted-Motors Hexacopter UAS Flying on a Perturbed Environment
Arizaga-Leon, Jorge Manuel; Castaneda, Herman; Castillo, Pedro
11:20-11:40  WeA4.5

Architecture-Independent Quaternion-Based Attitude Planning and Control Allocation for Multirotors
Borges Farçoni, Leonardo; Terra, Marco Henrique; Inoue, Roberto Santos
11:40-12:00  WeA4.6

Trajectory-Tracking of a Heterogeneous Formation Using Null Space-Based Control
Ernandes, Valentim; Sarcinelli-Filho, Mário; Brandao, Alexandre Santos
12:00-12:20  WeA4.7

WeB1 - Heritage B: Path Planning II
Chair: Rothmund, Sverre Velten  Co-Chair: Morrison, James R.
15:00-15:20  WeB1.1

A 3D Mobility Model for Autonomous Swarms of Collaborative UAVs
Falomir, Ema; Chaumette, Serge; Guerrini, Gilles
15:20-15:40  WeB1.2

Robust Multi-UAV Route Planning Considering UAV Failure
Putel, Ruchir; Rudnick-Cohen, Eliot; Azarm, Shapour; Herrmann, Jeffrey
15:40-16:00  WeB1.3

Routing Problems for Reconnaissance Patrolling Missions
Rajan, Sudarshan; Sundar, Kaarthik; Gautam, Natarajan
16:00-16:20  WeB1.4

Risk-Based Obstacle Avoidance in Unknown Environments Using Scenario-Based Predictive Control for an Inspection Drone Equipped with Range Finding Sensors
Rothmund, Sverre Velten; Johansen, Tor Arne
16:20-16:40  WeB1.5

Flight Patterns for Clouds Exploration with a Fleet of UAVs
Verdu, Titouan; Hattenberger, Gautier; Lacroix, Simon
16:40-17:00  WeB1.6

On Systems of UAVs for Persistent Security Presence: A Generic Network Representation, MDP Formulation and Heuristics for Task Allocation
Kim, Minjun; Morrison, James R.
WeB2 - Heritage A: Swarms II
Chair: Castaneda, Herman  Co-Chair: Castillo, Pedro
15:00-15:20  WeB2.1
(76) A Computational Tool to Assess Communications' Range and Capacity Limits of Ad-Hoc Networks of UAVs Operating in Maritime Scenarios
Oliveira, Tiago; Agamyrrzyansc, Anna; Correia, Luis
15:20-15:40  WeB2.2
(91) Probabilistic Search and Track with Multiple Mobile Agents
Papaioannou, Savvas; Kolios, Panayiotis; Theocarides, Theocharis; Panayiotou, Christos; Polycarpou, Marios M.
15:40-16:00  WeB2.3
(93) Backstepping-Based Controller for Flight Formation
Flores Palmeros, Pedro; Castillo, Pedro; Castanos, Fernando
16:00-16:20  WeB2.4
(218) Containment Control Based on Adaptive Sliding Mode for a MAV Swarm System under Perturbation
Katt, Carlos; Castaneda, Herman
16:20-16:40  WeB2.5
(168) Time-Delay Control of a Multi-Rotor VTOL Multi-Agent System towards Transport Operations
Alvarez Muñoz, Jonatan Uziel; Castillo Zamora, Jose de Jesus; Escareno Castro, Juan Antonio; Boussaada, Islam; Méndez-Barrios, César Fernando; Labbani, Ouidad
16:40-17:00  WeB2.6
(160) Formation Control and Navigation of a Quadrotor Swarm
Fernando, Malintha; Liu, Lantao

WeB3 - Heritage C: UAS Applications I
Chair: Vitzilaios, Nikolaos
15:00-15:20  WeB3.1
(63) Discrete-Time Control of LineDrone: An Assisted Tracking and Landing UAV for Live Power Line Inspection and Maintenance
Hamelin, Philippe; Mirallès, François; Lambert, Ghislain; Lavoie, Samuel; Pouliot, Nicolas; Montfrond, Matthieu; Montambault, Serge
15:20-15:40  WeB3.2
(152) Autonomous Aerial Robotic Exploration of Subterranean Environments Relying on Morphology-Aware Path Planning
Papachristos, Christos; Khattak, Shehryar; Mascarich, Frank; Dang, Tung; Alexis, Kostas
15:40-16:00  WeB3.3
(173) Building Mosaics Using Images Autonomously Acquired by a UAV
Amorim, Lúcio André; Vassallo, Raquel; Sarcinelli-Filho, Mário
16:00-16:20  WeB3.4
(213) Planning System for Integrated Autonomous Infrastructure Inspection Using UAVs
Ramon Soria, Pablo; Perez Jimenez, Manuel; Arrue, B.C.; Ollero, Anibal
16:20-16:40  WeB3.5
(205) Dynamic Structural Health Monitoring Using a DIC-Enabled Drone
Kalaitzakis, Michail; Kattil, Sreehari Rajan; Vitzilaios, Nikolaos; Rizos, Dimitris; Sutton, Michael
16:40-17:00  WeB3.6
(197) UAV Aided Dynamic Routing of Resources in a Flood Scenario
Kashyap, Abhishek; Ghose, Debashish; Prathyush, Purushothama Menon; Sujit, P. B; Das, Kaushik

WeB4 – Savannah: Control Architectures II
Chair: Sharma, Rajnikant
15:00-15:20  WeB4.1
(4) Design and Implementation of an Artificial Neural Network Wavelet for Load Transportation with Two Unmanned Aircraft Systems
Juarez Vargas, Cesar Eduardo; Suárez Cansino, Jóel; Espinoza Quesada, Eduardo Steed; Garcia Carrillo, Luis Rodolfo; Ramos-Velasco, Luis Enrique; Lozano, Rogelio
15:20-15:40  WeB4.2
(7) Robustness Studies on Quadrotor Control
Brossard, Jérémy; Bensoussan, David; Landry, René Jr.; Hammami, Maher
15:40-16:00 WeB4.3
(111) Flight Control Methods for Multirotor UAS
Ackerman, Kasey; Gregory, Irene; Hovakimyan, Naira
16:00-16:20 WeB4.4
(171) A Survey of Artificial Neural Networks with Model-Based Control Techniques for Flight Control of Unmanned Aerial Vehicles
Gu, Weibin; Valavanis, Kimon; Rutherford, Matthew; Rizzo, Alessandro
16:20-16:40 WeB4.5
(174) Centroid Vectoring Control Using Aerial Manipulator: Experimental Results
Ivanovic, Antun; Car, Marko; Orsag, Matko; Bogdan, Stjepan
16:40-17:00 WeB4.6
(191) Robust and Synchronous Nonlinear Controller for Autonomous Formation Flight of Fixed Wing UASs
Cordeiro, Thiago; Ferreira, Henrique Cezar; Ishihara, João Yoshiyuki

WeC1 - Heritage B: Fault Diagnosis, Accommodation and Fault-Tolerant Control
Chair: Hasan, Agus
17:00-17:20 WeC1.1
(145) Interactive Multiple Neural Adaptive Observer Based Sensor and Actuator Fault Detection and Isolation for Quadcopter
Lee, Woo-Cheol; Choi, Han-Lim
17:20-17:40 WeC1.2
(42) Observer-Based Super Twisting Controller Robust to Wind Perturbation for Multirotor UAV
Hamadi, Husseine; Lussier, Benjamin; Fantoni, Isabelle; Francis, Clovis; Shraim, Hassan
17:40-18:00 WeC1.3
(154) Model-Based Fail-Safe Module for Autonomous Multirotor UAVs with Parachute Systems
Hasan, Agus; Tofterup, Vincent Klyverts; Jensen, Kjeld
18:00-18:20 WeC1.4
(103) Actuator Fault Diagnosis and Fault Tolerant Control Using Intelligent-Output-Estimator Applied on Quadrotor UAV
Al Younes, Younes; Noura, Hassan; Rabhi, Abdelhamid; El Hajjaji, Ahmed
18:20-18:40 WeC1.5
(178) Fault-Tolerant Adaptive Neural Control of Multi-UAVs against Actuator Faults
Yu, Ziquan; Zhang, Youmin; Qu, Yaohong; Su, Chun-Yi; Zhang, Yintao; Xing, Zhewen

WeC2 - Heritage A: Regulations
Chair: Bassi, Eleonora
17:00-17:20 WeC2.1
(26) Drones Are Flying Outside of Segregated Airspace in Poland – New Rules for BVLOS UAVs Operations
Konert, Anna; Kasprzyk, Piotr
17:20-17:40 WeC2.2
(52) A Survey of Unmanned Aircraft System Technologies to Enable Safe Operations in Urban Areas
Bloise, Nicoletta; Primatesta, Stefano; Antonini, Roberto; Fici, Gian Piero; Gaspardone, Marco; Guglieri, Giorgio; Rizzo, Alessandro
17:40-18:00 WeC2.3
(55) European Drones Regulation: Today's Legal Challenges
Bassi, Eleonora
18:00-18:20 WeC2.4
(119) Risk Assessment Based on SORA Methodology for a UAS Media Production Application
Capitán, Carlos; Capitan, Jesus; Castaño, Ángel Rodríguez; Ollero, Anibal
18:20-18:40 WeC2.5
(210) Towards a Tool for Assessing UAS Compliance with the JARUS SORA Guidelines
Terkildsen, Kristian Husum; Jensen, Kjeld
### WeC3 - Heritage C: UAS Applications II

**Chair:** Lozano, Rogelio  
University of Technology of Compiègne  
**Time:** 17:00-17:20  
**WeC3.1**

*Comparative Study for Coordinating Multiple Unmanned HAPS for Communications Area Coverage*
Anicho, Ogbonnaya; Charlesworth, Philip; Baicher, Gurvinder; Nagar, Atulya; Buckley, Neil  
**Time:** 17:20-17:40

*Water Take-Off and Landing - Hybrid Copter Approach for Maritime CONOPs*
Galante, João; Manuel, Ribeiro; de Nobrega, Roberto; Neiva, Jorge; Ferreira, António Sérgio; Sousa, Joao  
**Time:** 17:40-18:00

*Three Dimensional UAV Path Following Using SDRE Guidance*
Singh, Mandeep; Manoharan, Amith; Ratnoo, Ashwini; P. B., Sujit  
**Time:** 18:00-18:20

*Satellite and UAV Data for Precision Agriculture Applications*
Mancini, Adrianio; Frontoni, Emanuele; Zingaretti, Primo  
**Time:** 18:20-18:40

*Attitude and Altitude Control for a Fixed Wing UAV Applied to Photogrammetry*
Hernandez, Jorge Luis; Gonzalez-Hernandez, Ivan; Lozano, Rogelio  
**Time:** 18:40 – 19:00

*Wildfire Monitoring with Uneven Importance Using Multiple Unmanned Aircraft Systems*
Hu, Xiaolin; Bent, John; Sun, Jiawei  
(Moved to this Session for presentation from FrA4)

### WeC4 – Savannah: Control Architectures III

**Chair:** Azimov, Dilmurat  
Co-Chair: Zhang, Fu  
**Time:** 17:00-17:20  
**WeC4.1**

*Nonlinear Model Predictive Attitude Control for Fixed-Wing Unmanned Aerial Vehicle Based on a Wind Frame Formulation*
Reinhartd, Dirk; Johansen, Tor Arne  
**Time:** 17:20-17:40

*Integrated Optimal Control and Explicit Guidance for Quadcopters*
Kawamura, Evan; Azimov, Dilmurat  
**Time:** 17:40-18:00

*Deep Reinforcement Learning Attitude Control of Fixed-Wing UAVs Using Proximal Policy Optimization*
Bøhn, Eivind; Coates, Erlend M.; Moe, Signe; Johansen, Tor Arne  
**Time:** 18:00-18:20

*Enabling Bidirectional Thrust for Aggressive and Inverted Quadrotor Flight*
Jothiraj, Walter; Miles, Corey; Bulka, Eitan; Sharf, Inna; Nahon, Meyer  
**Time:** 18:20-18:40

*Full Attitude Control of an Efficient Quadrotor Tail-Sitter VTOL UAV with Flexible Modes*
Xu, Wei; Gu, Haowei; Qin, Youming; Lin, Jiarong; Zhang, Fu

### WeP5 - Heritage Foyer: Poster Papers

**Chair:** Morrison, James R.  
**Time:** 13:00-18:00  
**WeP5.1**

*Robust Flight Control of a Tri-Rotor UAV Based on Modified Super-Twisting Algorithm*
Paiva, Enrique; Rodas, Jorge; Kali, Yassine; Gregor Recalde, Raul Igmar; Saad, Maarouf  
**Time:** 13:00-18:00

*On Coordination in Multiple Aerial Engagement*, pp. 549-554.  
Strickland, Laura; Squires, Eric; Day, Michael; Pippin, Charles  
**Time:** 13:00-18:00

*Planning for Decentralized Formation Flight of UAV Fleets in Uncertain Environments with Dec-POMDP*
de Oliveira Floriano, Bruno Rodolfo; Borges, Geovany Araújo; Ferreira, Henrique Cezar  
**Time:** 13:00-18:00

*Smart City Investments: A Rapid Decision Framework for Public Private Partnerships*
Rayi, Paul Sujith; Bothra, Rishie Lavendra; Wallace, Stephen; Venkatesh, Murali  
**Time:** 13:00-18:00

*Sense-And-Avoid System Development on an FPGA*

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Technical Program for Thursday June 13, 2019

ThA1 - Heritage B: Path Planning III
Chair: Darbha, Swaroop  Co-Chair: Choi, Youngjun
10:00-10:20  ThA1.1
(45) Cooperative Search Area Optimization Using Multiple Unmanned Aerial Vehicles in a GPS-Denied Environment
Misra, Sohum; Biswas, Srijanee; Minai, Ali; Sharma, Rajnikant
10:20-10:40  ThA1.2
(109) Randomized Continuous Monitoring of a Target by Agents with Turn Radius Constraints
Stephens, Shawn; Manyam, Satyanarayana Gupta; Casbeer, David; Cichella, Venanzio; Kunz, Donald
10:40-11:00  ThA1.3
(122) A Multi-UAS Trajectory Optimization Methodology for Complex Enclosed Environments
Barlow, Sarah; Choi, Youngjun; Briceno, Simon; Mavris, Dimitri
11:00-11:20  ThA1.4
(139) Efficient Computation of Optimal UAV Routes for Persistent Monitoring of Targets
Hari, Sai Krishna Kanth; Rathinam, Sivakumar; Darbha, Swaroop; Kalyanam, Krishna; Manyam, Satyanarayana Gupta; Casbeer, David
11:20-11:40  ThA1.5
(141) Bounding Algorithms for Persistent Monitoring of Targets Using Unmanned Vehicles
Hari, Sai Krishna Kanth; Rathinam, Sivakumar; Darbha, Swaroop; Kalyanam, Krishna; Manyam, Satyanarayana Gupta; Casbeer, David
11:40-12:00  ThA1.6
(225) System Design and Resource Analysis for Persistent Robotic Presence with Multiple Refueling Stations
Park, Hyorin; Morrison, James R.

ThA2 - Heritage C: UAS Applications III
Chair: Johansen, Tor Arne
10:00-10:20  ThA2.1
(20) Feasibility Study for a MEDEVAC Electric UAS Capability
Pickell, William; Kopeikin, Andrew; Bristow, Elizabeth; Bluman, James
10:20-10:40  ThA2.2
(39) Multi-UAV Based Autonomous Wilderness Search & Rescue Using Target Iso-Probability Curves
Kashino, Zendai; Nejat, Goldie; Benhabib, Beno
10:40-11:00  ThA2.3
(99) Cooperative Load Transportation Using Three Quadrotors
Pizetta, Igor; Brandao, Alexandre Santos; Sarcinelli-Filho, Mário
11:00-11:20  ThA2.4
(115) Colored-Noise Tracking of Floating Objects Using UAVs with Thermal Cameras
Helgesen, Haakon Hagen; Stendahl Leira, Frederik; Johansen, Tor Arne
11:20-11:40  ThA2.5
(179) A Solution for Searching and Monitoring Forest Fires Based on Multiple UAVs
Zhang, Yintao; Zhang, Youmin; Yu, Ziquan
11:40-12:00  ThA2.6
Dang, Tung; Khattak, Shehryar; Papachristos, Christos; Alexis, Kostas

ThA3 - Heritage A: Micro and Mini UAS
Chair: Chao, Haiyang
10:00-10:20  ThA3.1
(47) A Novel Quadcopter with a Tilting Frame Using Parallel Link Mechanism
Sakaguchi, Akinori; Takimoto, Takashi; Ushio, Toshimitsu
10:20-10:40  ThA3.2
(100) Direct Position Control of an Octarotor Unmanned Vehicle under Wind Gust Disturbance
Baldini, Alessandro; Felicetti, Riccardo; Freddi, Alessandro; Longhi, Sauro; Monteriù, Andrea
10:40-11:00 ThA3.3
(106) Smooth Saturation Function-Based Position and Attitude Tracking of a Quad-Rotorcraft Avoiding Singularity
Dasgupta, Ranjan
11:00-11:20 ThA3.4
(133) Error-State LQR Control of a Multirotor UAV
Farrell, Michael David; Jackson, James; Nielsen, Jerel; Bidstrup, Craig; McLain, Timothy W.
11:20-11:40 ThA3.5
(169) A Fuzzy Gain Scheduling Control Algorithm for Formation Flight of Multi-UAVs
Rojo Rodriguez, Erik Gilberto; Ollervides Vazquez, Edmundo Javier; Zambrano-Robledo, Patricia; Garcia Salazar, Octavio
11:40-12:00 ThA3.6
(214) Model Based Roll Controller Tuning and Frequency Domain Analysis for a Flying-Wing UAS
Planagan, Harold; Chao, Haiyang; Hagerott, Steven G.

ThA4 – Savannah: Energy Efficient UAS
Chair: Ollero, Anibal Co-Chair: Bezzo, Nicola
10:00-10:20 ThA4.1
(71) A Simple Model for Gliding and Low-Amplitude Flapping Flight of a Bio-Inspired UAV
Martín-Alcántara, Antonio; Grau, Pedro; Fernández-Feria, Ramón; Ollero, Anibal
10:20-10:40 ThA4.2
(74) Multiphysical Modeling of Energy Dynamics for Multirotor Unmanned Aerial Vehicles
Michel, Nicolas; Sinha, Anish Kumar; Kong, Zhaodan Kong; Lin, Xinfan
10:40-11:00 ThA4.3
(101) Propulsion System Modeling for Small Fixed-Wing UAVs
Coates, Erlend M.; Wenz, Andreas Wolfgang; Gryte, Kristoffer; Johansen, Tor Arne
11:00-11:20 ThA4.4
(116) Grid-Based Coverage Path Planning with Minimum Energy Over Irregular-Shaped Areas with UAVs
Cabreira, Tauã; Di Franco, Carmelo; Ferreira Jr., Paulo R.; Buttazzo, Giorgio
11:20-11:40 ThA4.5
(162) Exploiting Ground and Ceiling Effects on Autonomous UAV Motion Planning
Gao, Shijie; Di Franco, Carmelo; Carter, Darius; Quinn, Daniel; Bezzo, Nicola
11:40-12:00 ThA4.6
(189) Mission Planning Strategy for Multicopter UAV Based on Flight Endurance Estimation
Schacht Rodríguez, Ricardo; Ponsart, Jean-Christophe; Garcia Beltran, Carlos Daniel; Astorga-Zaragoza, Carlos; Theilliol, Didier

ThB1 - Heritage B: Path Planning IV
Chair: Morrison, James R. Co-Chair: Ahmadian, Navid
13:30-13:50 ThB1.1
(80) A Study on 3D Optimal Path Planning for Quadcopter UAV Based on D* Lite
Kim, Hyowon; Jeong, Jinseok; Kim, Namyool; Kang, Beomsoo
13:50-14:10 ThB1.2
(98) Collision-Free Multi-UAV Flight Scheduling for Power Network Damage Assessment
Ahmadian, Navid; Lim, Gino; Torabbeigi, Maryam; Kim, Seon Jin
14:10-14:30 ThB1.3
(114) Multi-UAS Path-Planning for a Large-Scale Disjoint Disaster Management
Choi, Younghoon; Choi, Youngjun; Briceno, Simon; Mavris, Dimitri
14:30-14:50 ThB1.4
(184) A UAV Resolution and Waveband Aware Path Planning for Onion Irrigation Treatments Inference
Niu, Haoyu; Zhao, Tiebiao; Wang, Dong; Chen, YangQuan;
14:50-15:10 ThB1.5
(229) Data Quality Aware Flight Mission Design for Fugitive Methane Sniffing Using Fixed Wing Suas
Hollenbeck, Derek; Dahra, Moataz; Christensen, Lance; Chen, YangQuan
15:10-15:30 ThB1.6
(237) A Unified Framework for Reliable Multi-Drone Tasking in Emergency Response Missions
Terzi, Maria; Kolios, Panayiotis; Panayiotou, Christos; Theocharides, Theocharis
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<th>Session</th>
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<td>ThB2.1</td>
<td><strong>Patrolling a Terrain with Cooperative UAVs Using Random Walks</strong></td>
<td>Caraballo de la Cruz, Luis Evaristo; Díaz-Báñez, José-Miguel; Fabila-Monroy, Ruy Hidalgo-Toscano, Carlos</td>
<td>13:30-13:50</td>
<td>ThB2</td>
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<tr>
<td>ThB2.2</td>
<td><strong>Rapid and Automated Urban Modeling Techniques for UAS Applications</strong></td>
<td>Choi, Youngjun; Pate, David; Briceno, Simon; Mavris, Dimitri</td>
<td>13:50-14:10</td>
<td>ThB2</td>
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<td>ThB2.3</td>
<td><strong>Communication Technology for Unmanned Aerial Vehicles: A Qualitative Assessment and Application to Precision Agriculture</strong></td>
<td>Neji, Najett; Mostfa, Tumader</td>
<td>13:50-14:50</td>
<td>ThB2</td>
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<td>ThB2.4</td>
<td><strong>UAVs at Your Service: Towards IoT Integration with HAMSTER</strong></td>
<td>Rodrigues, Mariana; Branco, Kalinka Regina Lucas Jaquie Castelo</td>
<td>14:10-14:30</td>
<td>ThB2</td>
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<tr>
<td>ThB2.5</td>
<td><strong>Urban Monitoring of Smart Communities Using UAS</strong></td>
<td>Pannozzi, Pierluigi; Valavanis, Kimon; Rutherford, Matthew; Guglieri, Giorgio; Scanavino, Matteo; Quagliotti, Fulvia</td>
<td>14:30-14:50</td>
<td>ThB2</td>
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<td>ThB2.6</td>
<td><strong>Control of a PVTOL with Tilting Rotors</strong></td>
<td>Offermann, Alexis; Castillo, Pedro; De Miras, Jérôme (Moved to this Session for presentation from FrB4)</td>
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<td>ThB3.1</td>
<td><strong>Increasing Perception Space of a Ground Standing Robot Via Data Transmission from an Aerial Robot</strong></td>
<td>Sohn, Kiwon; Murshid, Mohammad</td>
<td>13:30-13:50</td>
<td>ThB3</td>
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<tr>
<td>ThB3.2</td>
<td><strong>Perceptual Ability Advancement of a Humanoid with Limited Sensors Via Data Transmission from an Aerial Robot</strong></td>
<td>Sohn, Kiwon; Murshid, Mohammad</td>
<td>13:50-14:10</td>
<td>ThB3</td>
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<tr>
<td>ThB3.3</td>
<td><strong>State Estimation for Aerial Vehicles in Forest Environments</strong></td>
<td>Chiella, Antonio Carlos Bana Chiella; Teixeira, Bruno Otávio S.; Pereira, Guilherme</td>
<td>14:30-14:50</td>
<td>ThB3</td>
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<td>ThB3.4</td>
<td><strong>Deep Learning Based Semantic Situation Awareness System for Multirotor Aerial Robots Using LIDAR</strong></td>
<td>Sanchez-Lopez, Jose Luis; Sampedro, Carlos; Cazzato, Dario; Voos, Holger</td>
<td>14:50-15:10</td>
<td>ThB3</td>
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<td>ThB3.5</td>
<td><strong>Networked Radar Systems for Cooperative Tracking of UAVs</strong></td>
<td>Anderson, Brady; Ellingson, Jaron; Eyler, Michael; Buck, David; Peterson, Cameron; McLain, Timothy W.; Warnick, Karl</td>
<td>15:10-15:30</td>
<td>ThB3</td>
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<td>ThB3.6</td>
<td><strong>Depth Map Estimation Methodology for Detecting Free-Obstacle Navigation Areas</strong></td>
<td>Trejo, Sergio Marcelino; Martínez, Karla; Flores, Gerardo</td>
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<tr>
<td>ThB4.1</td>
<td><strong>Optimum Design for Drone Highway Network</strong></td>
<td>Hamanaka, Masatoshi</td>
<td>13:30-13:50</td>
<td>ThB4</td>
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<td>ThB4.2</td>
<td><strong>Distributed Bidding-Based Detect-And-Avoid for Multiple Unmanned Aerial Vehicles in National Airspace</strong></td>
<td>Scott, Drew; Radmanesh, Mohammadreza; Sarim, Mohammad; Deshpande, Aditya; Kumar, Manish; Pragada, Ravikumar</td>
<td>13:50-14:10</td>
<td>ThB4</td>
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<td>14:10-14:30</td>
<td>ThB4</td>
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</table>
A Lane-Based Approach for Large-Scale Strategic Conflict Management for UAS Service Suppliers
Sacharny, David; Henderson, Thomas
14:30-14:50 ThB4.4

Probability-Based Collision Detection and Resolution of Planned Trajectories for Unmanned Aircraft System Traffic Management
Ko, Woo-Hyun; Kumar, P. R.
14:50-15:10 ThB4.5

Evolutionary Optimization-Based Mission Planning for UAS Traffic Management (UTM)
Tan, Qingyu; Wang, Zenkun; Yew Soon, Ong; Low, Kin Huat
15:10-15:30 ThB4.6

Enable UAVs Safely Flight in Low-Altitude: A Preliminary Research of the Public Air Route Network of UAVs
Liao, Xiaohan; Xu, Chenchen; Yue, Huanyin

ThC1 - Heritage B: See-And-Avoid Systems
Chair: Briese, Christoph
16:00-16:20 ThC1.1

Below Horizon Aircraft Detection Using Deep Learning for Vision-Based Sense and Avoid
James, Jasmin; Ford, Jason; Molloy, Timothy L.
16:20-16:40 ThC1.2

High-Speed Obstacle-Avoidance with Agile Fixed-Wing Aircraft
Bulka, Eitan; Nahon, Meyer
16:40-17:00 ThC1.3

Deep Learning with Semi-Synthetic Training Images for Detection of Non-Cooperative UAVs
Briese, Christoph; Günther, Lukas
17:00-17:20 ThC1.4

Flight Test Validation of Collision Avoidance System for a Multicopter Using Stereoscopic Vision
Ma, Demetria; Tran, Alex; Keti, Nick; Yanagi, Ryan; Knight, Peter; Joglekar, Kedar; Tudor, Nicholas; Cresta, Burt; Bhandari, Subodh
17:20-17:40 ThC1.5

Three-Dimensional (3D) Dynamic Obstacle Perception in a Detect-And-Avoid Framework for Unmanned Aerial Vehicles
Lim, Catrina; Li, Boyang; Ng, Ee Meng; Liu Xin; Low, Kin Huat

ThC2 - Heritage C: UAS Applications V
Chair: Peterson, Cameron Co-Chair: Brandao, Alexandre Santos
16:00-16:20 ThC2.1

The Urban Last Mile Problem: Autonomous Drone Delivery to Your Balcony
Brunner, Gino; Szebedy, Bence; Tanner, Simon; Wattenhofer, Roger
16:20-16:40 ThC2.2

Real-Time Single Object Detection on the UAV
Wu, Hsiang-Huang
16:40-17:00 ThC2.3

Gesture Commands for Controlling High-Level UAV Behavior
Akagi, John; Moon, Brady; Chen, Xingguang; Peterson, Cameron
17:00-17:20 ThC2.4

UAS-Based Crack Detection Using Stereo Cameras: A Comparative Study
Benkhoui, Yasmine; Reinhold, Ludwig; El Korchi, Tahar
17:20-17:40 ThC2.5

Rod-Shaped Payload Transportation Using Multiple Quadrotors
Villa, Daniel Khede Dourado; Brandao, Alexandre Santos; Sarcinelli-Filho, Mário

ThC3 - Heritage A: Sensor Fusion II
Chair: Sun, Liang
16:00-16:20 ThC3.1

Observability Analysis and Bayesian Filtering for Self-Localization of a Tethered Multicopter in GPS-Denied Environments
Al-Radaideh, Amer; Sun, Liang
16:20-16:40   ThC3.2
(149) A Survey of Inertial Sensor Fusion: Applications in sUAS Navigation and Data Collection
Givens, Matthew; Coopmans, Calvin
16:40-17:00  ThC3.3
(147) An Estimation-Domain Approach to MEMS Multi-IMU Fusion for SUAS
Givens, Matthew; Coopmans, Calvin; Christensen, Randall
17:00-17:20  ThC3.4
(220) Robust Thermal-Inertial Localization for Aerial Robots: A Case for Direct Methods
Khattak, Shehryar; Mascari, Frank; Dang, Tung; Papachristos, Christos; Alexis, Kostas
17:20-17:40  ThC3.5
(236) A Software in the Loop (SIL) Kalman and Complementary Filter Implementation on X-Plane for UAVs
Michailidis, Michail; Agha, Mohammed; Rutherford, Matthew; Valavanis, Kimon

ThC4 – Savannah: Airspace Control
Chair: Uchiyama, Kenji
16:00-16:20  ThC4.1
(25) Linear Quadratic Formulation of the Target Defense Differential Game
Pachter, Meir; Casbeer, David; Garcia, Eloy
16:20-16:40  ThC4.3
(156) Controller Design Using Backstepping Algorithm for Fixed-Wing UAV with Thrust Vectoring System
Hirano, Shogo; Uchiyama, Kenji; Masuda, Kai
16:40-17:00  ThC4.4
(201) Least Square Policy Iteration for IBVS Based Dynamic Target Tracking
Srivastava, Raunak; Lima, Rolif; Das, Kaushik; Maity, Arnab
17:00-17:20  ThC4.5
(49) Robust Trajectory Tracking for UAS: Dynamics Sliding Mode Approach
Reynoso, Martin; Srivastava, Raunak; Lima, Rolif; Das, Kaushik; Maity, Arnab
17:20-17:40  ThC4.6

Technical Program for Friday June 14, 2019

FrA1 - Heritage B: UAV Design
Chair: Cawthorne, Dylan  Co-Chair: Kim, Yongjae
09:00-09:20  FrA1.1
(3) Design and Shape Optimization of Unmanned, Semi-Rigid Airship for Rapid Descent Using Hybrid Genetic Algorithm
Singh, Vinay; Lanteigne, Eric
09:20-09:40  FrA1.2
(31) Preliminary Design, Modeling and Control of a Fully Actuated Quadrotor UAV
Nigro, Michelangelo; Pierr, Francesco; Caccavale, Fabrizio
09:40-10:00  FrA1.3
(59) Value Sensitive Design of a Humanitarian Cargo Drone
Cawthorne, Dylan; Cenci, Alessandra
10:00-10:20  FrA1.4
(70) Design of a Class I Unmanned Aircraft for Maritime Surveillance
Franco, Vasco; Correia, João; Caetano, Joao Vieira; Félix, Luís
10:20-10:40  FrA1.5
(144) Design Methodology of a Small Unmanned Airship with Optimized Fins
Suvarna, Sohan; Chung, Hoam; Pant, Rajkumar
10:40-11:00  FrA1.6
Kim, Yongjae; Kim, Gyeong Hun; Choi, Jae-Hyun
11:00-11:20  FrA1.7
FrA2 - Heritage A: Autonomy I
Chair: Bezzo, Nicola
09:00-09:20 FrA2.1
(9) Singular Trajectories in the Two Pursuer One Evader Differential Game
Pachter, Meir; Von Moll, Alexander; Garcia, Eloy; Casbeer, David; Milutinovic, Dejan
09:20-09:40 FrA2.2
(12) Deep RC: Enabling Remote Control through Deep Learning
Ellingson, Jaron; Ellingson, Gary; McLain, Timothy W.
09:40-10:00 FrA2.3
(226) Parameter-Free Regression-Based Autonomous Control of Off-The-Shelf Quadrotor UAVs
Peddi, Rahul; Bezzo, Nicola
10:00-10:20 FrA2.4
(163) Towards Breaching a Still Water Surface with a Miniature Unmanned Aerial-Underwater Vehicle
Zha, Jiaming; Thacher, Eric William; Kroeger, Joseph; Makiharju, Simo; Mueller, Mark Wilfried
10:20-10:40 FrA2.5
(158) A Vision-Based Unmanned Aircraft System for Autonomous Grasp & Transport
Liu, Xu; He, Yuqing; Chen, Bo; Hou, Yongqiang; Bi, Kaiyuan; Li, Decai

FrA3 - Heritage C: Navigation I
Chair: Campoy, Pascual Co-Chair: Huang, Sunan
09:00-09:20 FrA3.1
(11) Visual Controllers for Relative Positioning in Indoor Settings
Mejias Alvarez, Luis; Campoy, Pascual
09:20-09:40 FrA3.2
(82) Towards Automated Under-Canopy Exploration of Plantation Forests
Lin, Tzu-Jui; Stol, Karl
09:40-10:00 FrA3.3
(34) Laser-Based Collision Avoidance and Reactive Navigation Using RRT* and Signed Distance Field for Multirotor UAVs
Lu, Liang; Sampedro, Carlos; Rodriguez-Vazquez, Javier; Campoy, Pascual
10:00-10:20 FrA3.4
(51) Computationally Efficient Visibility Graph—Based Generation of 3D Shortest Collision-Free Path among Polyhedral Obstacles for Unmanned Aerial Vehicles
Huang, Sunan; Teo, Rodney
10:20-10:40 FrA3.5
(53) A Cloud-Based Framework for Intelligent Navigation and Coordination for UASs in Urban Areas
Primatesa, Stefano; Bloise, Nicoletta; Antonini, Roberto; Fici, Gian Piero; Gasapardo, Marco; Guglieri, Giorgio; Rizzo, Alessandro
10:40-11:00 FrA3.6
(19) A Carrot in Probabilistic Grid Approach for Quadrotor Line Following on Vertical Surfaces
Liu, Jyi-Shane; Lee, Gong-Yi

FrA4 – Savannah: Environmental Issues
Co-Chair: Chen, YangQuan
09:00-09:20 FrA4.1
(1) Visual Servoing for Multirotor Precision Landing in Daylight and After-Dark Conditions
Wynn, Jesse S.; McLain, Timothy W.
09:20-09:40 FrA4.2
(185) Pitch and Roll Effects of On-Board Wind Measurements Using SUAS
Hollenbeck, Derek; Oyama, Madoka; Garcia, Andrew; Chen, YangQuan
09:40-10:00 FrA4.3
(108) Hybrid AutoGyro: Airborne Wind Energy Conversion Using Autorotation
Flores, Jonathan; Salazar, Sergio; Lozano, Rogelio
10:00-10:20 FrA4.4
(150) Modeling of Aerodynamic Disturbances for Proximity Flight of Multirotors
Jain, Karan; Fortmuller, Trey; Byun, Jaeseung; Makiharju, Simo; Mueller, Mark Wilfried
(13) Asymptotic Stability Controller Design of Three Fixed-Wing UAVs Formation with Windy Field
Pu, Zhang; Huifeng, Xue; Shan, Gao

FrB1 - Heritage B: Risk Analysis and Risk-Based Methods for UAS
Chair: Bertrand, Sylvain Co-Chair: la Cour-Harbo, Anders
Organizers: Bertrand, Sylvain; la Cour-Harbo, Anders
11:30-11:50 FrB1.1
(57) Feasibility Analysis of UAV Operations for Monitoring of Infrastructure Networks: A Risk-Based Approach (I)
Bertrand, Sylvain; Raballand, Nicolas; Lala, Stephanie; Flavien, Viguier
11:50-12:10 FrB1.2
(94) Modeling Unmanned Aerial System (UAS) Risks Via Monte-Carlo Simulation (I)
Rudnick-Cohen, Eliot; Herrmann, Jeffrey; Azarm, Shapour
12:10-12:30 FrB1.3
(104) Planning Unmanned Aerial System (UAS) Takeoff Trajectories to Minimize Third-Party Risk (I)
Rudnick-Cohen, Eliot; Azarm, Shapour; Herrmann, Jeffrey
12:30-12:50 FrB1.4
(155) Compromising Flight Paths of Autopiloted Drones
Chen, Wenxin; Dong, Yingfei; Duan, Zhenhai
12:50-13:10 FrB1.5
(212) Safe Decision Making for Risk Mitigation of UAS (I)
Castano, Lina; Xu, Huan

FrB2 - Heritage A: Autonomy II
Chair: Rodriguez Cortes, Hugo
11:30-11:50 FrB2.1
(204) Towards a Weather Analysis Software Framework to Improve UAS Operational Safety, pp. 1372-1380.
Lundby, Tobias; Christiansen, Martin Peter; Jensen, Kjeld
11:50-12:10 FrB2.2
(84) A Convolutional Neural Network Vision System Approach to Indoor Autonomous Quadrotor Navigation
Garcia, Adriano; Mittal, Sandeep; Kiewra, Edward; Ghose, Kanad
12:10-12:30 FrB2.3
(129) Flying through Gates Using a Behavioral Cloning Approach
Rodriguez Hernandez, Erick; Vasquez-Gomez, Juan Irving; Herrera Lozada, Juan Carlos
12:30-12:50 FrB2.4
(136) Monocular SLAM Position Scale Estimation for Quadrotor Autonomous Navigation
Rodriguez Cortes, Hugo; Gómez-Casasola, Alejandro; Luis Daniel, Nieto-Hernandez
12:50-13:10 FrB2.5
(177) Gaussian Mixture Model (GMM) Based Dynamic Object Detection and Tracking
Haritharan Anand, Vishnu; Pushp, Durgakant; Raj, Rishin; Das, Kaushik
13:10-13:30 FrB2.6
(54) Radius of Turn and Flight Path Angle Estimation from Unmanned Aircraft Flight Trajectories
Benders, Sebastian; Koch, Simon

FrB3 - Heritage C: Navigation II
Chair: Fossen, Thor I.
11:30-11:50 FrB3.1
(41) Approximating UAV and Vision Feature Point Correlations in a Simplified SLAM Problem
Lewis, Jeffrey; Johnson, Eric
11:50-12:10 FrB3.2
(67) Null Space Based Formation Control for a UAV Landing on a UGV
Mafra Moreira, Mauro Sergio; Brandao, Alexandre Santos; Sarcinelli-Filho, Mário
12:10-12:30 FrB3.3
(127) Field Test Results of GNSS-Denied Inertial Navigation Aided by Phased-Array Radio Systems for UAVs
Gryte, Kristoffer; Bryne, Torleiv Håland; Albrektsen, Sigurd M; Johansen, Tor Arne
12:30-12:50 FrB3.4
**UAV Based Survivor Search During Floods**
Ravichandran, Rahul; Ghose, Debasish; Das, Kaushik
12:50-13:10 FrB3.5

**Robust Navigation System for UAVs in GNSS and Magnetometer-Denied Environments**
Mathisen, Paal Holthe; Fossen, Thor I.
13:10-13:30 FrB3.6

**Pose Estimation of UAVs Based on INS Aided by Two Independent Low-Cost GNSS Receivers**
Sollie, Martin Lysvand; Bryne, Torleiv Håland; Johansen, Tor Arne

**FrB4 – Savannah: UAS Testbeds**
Chair: Theilliol, Didier Co-Chair: Ahmad, Shakeeb
11:30-11:50 FrB4.1

**(38) A New Facility for UAV Testing in Climate-Controlled Environments**
Scanavino, Matteo; Vilardi, Andrea; Guglieri, Giorgio
11:50-12:10 FrB4.2

**(81) Pitching Moment Analysis and Adjustment for Tilt-Wing UAV in VTOL Mode**
Sanchez-Rivera, Luz; Lozano, Rogelio; AriasMontano, Alfredo
12:10-12:30 FrB4.3

**(88) Control of a PVTOL with Tilting Rotors**, pp. 1451-1457. *(Will be presented in ThB2)*
Offermann, Alexis; Castillo, Pedro; De Miras, Jérome
12:10-12:30 FrB4.4

**(134) A Full Distributed Multipurpose Autonomous FlightSystem Using 3D Position Tracking and ROS**
Gargioni, Gustavo; Peterson, Marco; Persons, Jeffrey; Schroeder, Kevin; Black, Jonathan
12:30-12:50 FrB4.5

**(153) Real-Time Quadrotor Navigation through Planning in Depth Space in Unstructured Environments**
Ahmad, Shakeeb; Fierro, Rafael
12:50-13:10 FrB4.6

**(190) ROS-MAGNA, a ROS-Based Framework for the Definition and Management of Multi-UAS Cooperative Missions**
Millán Romera, José Andrés; Perez-Leon, Hector; Castillejo-Calle, Alejandro; Maza, Ivan; Ollero, Anibal