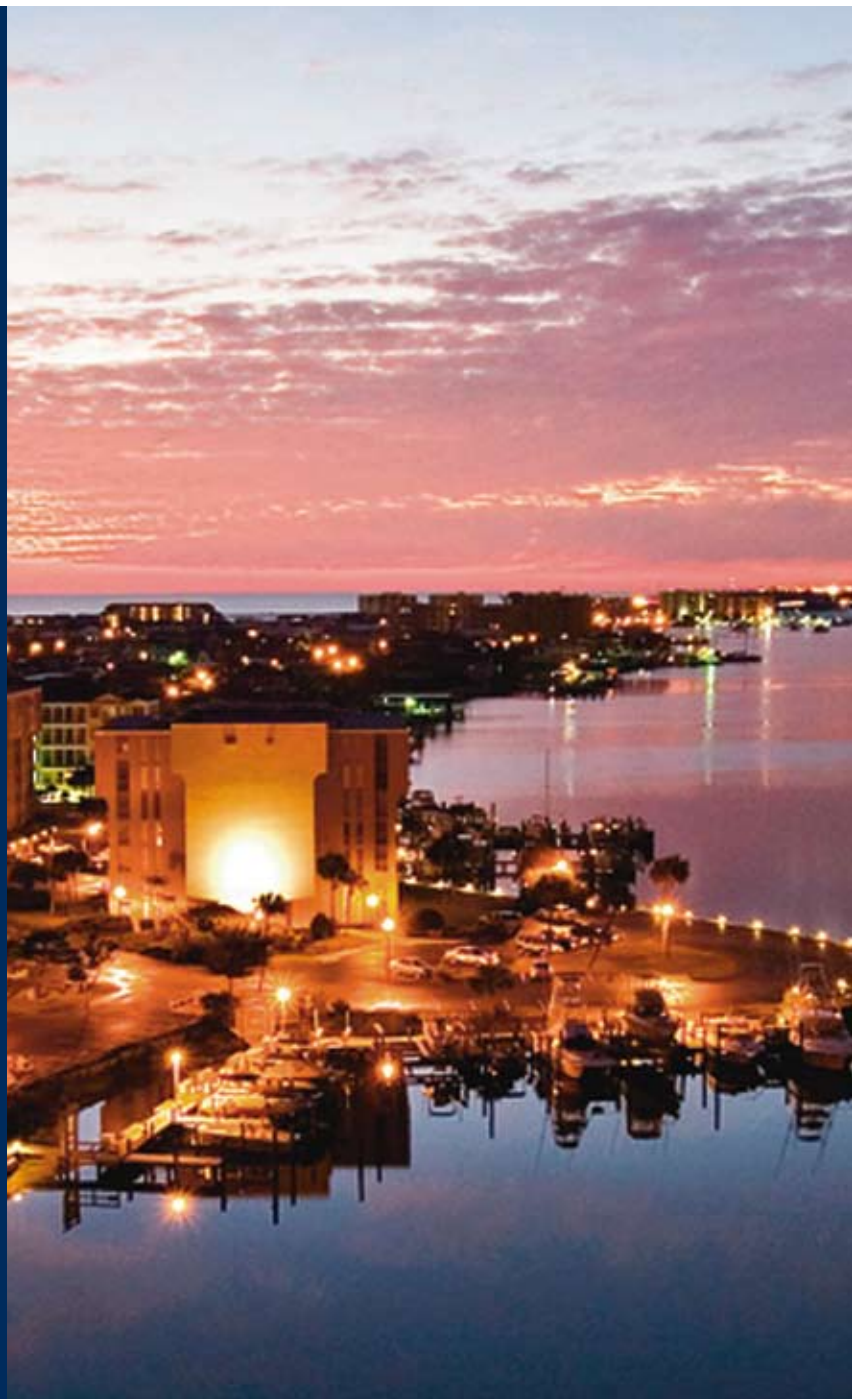


**ABSTRACTS DUE:  
JULY 31, 2009**

# **GNC Challenges for Miniature Autonomous Systems Workshop**

**October 26-28, 2009**  
***www.ion.org/mas***



**CALL FOR ABSTRACTS & WORKSHOP ANNOUNCEMENT**



**Sponsored By: The Air Force Research Lab, Munitions Directorate**

**Facilitated By: The Institute of Navigation**



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**Emerald Coast Conference Center  
Fort Walton Beach, FL**



# Workshop Co-Chairs, Planning Committee & Description

## Workshop Co-Chairs:

Mr. Fred Davis, *AFRL/RW*

Dr. Mikel Miller, *ION President*

Dr. Gregg Abate, *AIAA NWF Section Chair*



## Planning Committee:

Mr. Fred Davis, *AFRL Munitions Directorate*

Dr. Mikel Miller, *ION President*

Dr. Gregg Abate, *AIAA Northwest Florida Section Chair*

Dr. Tom Doligalski, *ARL/ARO*

Dr. Leslie Perkins, *AFRL Air Vehicles Directorate*

1Lt Caroline New, *AFRL Munitions Directorate*

## Workshop Description:

This workshop is intended to bring the DoD technical and user community, academia, and industry together to review and discuss advances in guidance, navigation, and control (GNC) for Miniature Autonomous Systems. Current trends show that future systems will be miniature (i.e., less than 20 lbs total system weight) for a number of reasons. First, they will be much cheaper to develop and build than current systems. Second, their smaller size will allow them to be carried in large numbers and be compatible with small UAVs for air-launched systems. Also, Miniature Autonomous Systems have the potential to fill the capability gap that is necessary for access to difficult targets such as hardened command and control facilities.

Miniature autonomous systems capable of agile locomotion or flight in urban, forested, and indoor (including transitions from outdoor to indoor) environments present many unique technical challenges to the controls and systems engineer. It is envisioned that the military use of miniature systems will include acquiring, tracking, and engaging non-traditional targets. Such miniature systems will use economies of scale and synergies in time-space trajectories to compensate for individual small payloads with subsequent small chemical and kinetic energies. There are many fundamental technical gaps that must be bridged so that we can build these systems. Today's small sensor apertures have poor resolution, making a MAS system that can be built today less observable and harder to control. Miniature systems, either airborne or ground-based, have built-in plant nonlinearities and instabilities stemming from the fact that some physical forces (e.g., viscous and friction) become comparable in magnitude to inertial forces. Miniature systems will also face fundamental challenges with insufficient actuation and will need to exploit small but dense power systems and (perhaps distributed) computational resources with limited performance.

A benefit of miniature weapon systems is the potential to greatly limit collateral damage in urban scenarios. However, very precise engagement is required to achieve the desired effects in defeating targets. Urban environments and scenarios offer unique GNC challenges for Miniature Autonomous Systems as well. Since small, agile vehicles will be required to traverse the complex flight environment in so-called "urban canyons" and the possibility exists that such systems will include both outdoor and indoor applications. "Tight" operating environments, clutter, obstacles, and RF interference can create situations where extremely agile GNC techniques are required. All of these applications will challenge GNC technologies for miniature autonomous systems. This workshop offers a review of active programs in the field, a window on significant trends, and the opportunity to present new technology to the community.

The workshop will feature presentations from leaders in the DoD technical and user communities, academia, and industry. The first day of the workshop will feature perspectives from the operations community, and GNC research challenge talks from senior research representatives of the Air Force, Navy, Army, and DARPA. The afternoon of the first day will feature For Official Use Only presentations. The second and third days of the workshop will feature public forum presentations and discussions including a variety of topics including Multi-use Miniature Seekers/Sensors; Advanced Navigation Sensors and Techniques; System Integration Challenges; and Multi-vehicle Cooperative Operations.



# GNC Challenges for Miniature Autonomous Systems Workshop

## Schedule: See [www.ion.org/mas](http://www.ion.org/mas) for Program Updates

**Monday, October 26, 2009**

### FOUO Sessions

**8:00 a.m. – 11:30 a.m.**

#### Plenary Session

##### Technical Speakers:

Dr. John Wilcox, *AFRL/RW*  
Dr. Leslie Perkins, *AFRL/RB*  
Dr. Tom Doligalski, *ARL/ARO*

##### Invited Operational Speakers:

Pete Chmelir, *NAVAIR-Weapons Division*  
Mike Bata, *ACC/A8ZW*  
Maj Travis Woodworth, *SOCOM*  
Col (ret) Hondo Geurts, *USSOCOM/SOAL/REO-FW*  
Marty Drake, *CENTCOM*

**1:30 p.m. – 5:00 p.m.**

#### FOUO Program Addresses

Abstracts are being accepted for this session which review and/or discuss advances in guidance, navigation, and control (GNC) for Miniature Autonomous Systems which must be presented in an FOUO environment.

**Tuesday, October 27, 2009**

### Public Access Sessions Day 1

**8:00 a.m. – 8:40 a.m.**

**Keynote Speaker: Prof. Rob Wood,**  
*Harvard University Microrobotics Lab*

**8:45 a.m. – 12:15 p.m.**

#### Miniature Multi-Function Seekers/Sensors

**Session Description:** Capability gaps are often highlighted during conflicts, and the scientific community is tasked to develop technical solutions to fill these gaps. Given the proliferation of UAVs, we have an opportunity to capitalize on these platforms to perform more than just the typical ISR function. Adding a precision strike capability against challenging target sets in confined urban environments requires smaller, more maneuverable UAVs. Additionally, miniature systems may have increased seeker/sensor requirements at the small scale. This will place strict requirements on the development of miniature, multi-function sensors/seekers enabling this capability. This session will highlight sensor/seeker technologies, and requirements which support this capability.

**Session Chairs:** Dr. Bill Humbert, *AFRL/RWGS*;  
Dr. Bryce Schumm, *AFRL/RYJM*

**1:30 p.m. – 5:00 p.m.**

#### Advanced Navigation Techniques

**Session Description:** This session focuses on advanced navigation techniques and methods for Miniature Autonomous Systems. In order to obtain robust position, navigation, and time (PNT) knowledge for a variety of Miniature Autonomous Systems, it is necessary to take advantage of new types of sensors and/or use existing sensors in innovative ways. This session will describe techniques and methods (vision-based navigation, gravity field navigation, magnetic field navigation, etc.) that exploit data from various sensors (i.e., cameras, laser-based systems, millimeter-wave radar, magnetometers, RF-based navigation sensors, combined communication/navigation systems, MEMS-based inertial systems, high sensitivity GPS, etc.). Of particular interest are PNT systems that operate where standard GPS is not available or is only partially available. Included in the concept of PNT are position, velocity, attitude, and precise time information. can work in situations where standard GPS is not available or is only partially available. Included in the concept of PNT are position, velocity, attitude, and precise time information.

**Session Chairs:** Dr. TJ Klausutis, *AFRL/RWGI*;  
Dr. John Raquet, *AFIT*

**Wednesday, October 28, 2009**

### Public Access Sessions Day 2

**8:00 a.m. – 11:30 a.m.**

#### System Integration Challenges

**Session Description:** Future GNC challenges for miniature autonomous systems will require novel integration approaches. This session focuses on the issues and challenges facing current and future GNC hardware and software algorithms for multi-sensor fusion in miniature systems. This session will feature innovative solutions used to integrate the hardware and software into a miniature "system of systems". That In order to meet the size, weight, and power restrictions associated with miniature systems, sensors will need to be multi-functional. For example, a Ladar could serve as a sensor and a line-of-site communication signal. Presentations discussing new ways of integrating traditional or innovative sensors are of interest.

**Session Chairs:** Mr. Johnny Evers, *AFRL/RWAV*;  
Harris Edge, *ARL*

**1:30 p.m. – 5:00 p.m.**

#### Controlling Miniature Autonomous Systems

**Session Description:** Miniature systems, either airborne or ground-based, have built-in plant nonlinearities and instabilities stemming from the fact that physical properties do not scale linearly nor proportionally. The viscous and friction forces may become comparable in magnitude to inertial forces at this scale. This session will focus on current research activities to meet the needs of plant observability, controllability, and stability for small autonomous systems. Research activities include: robust, distributed sensing and actuation architectures that exploit low quality sensors and low power effectors; adaptive control strategies that take advantage of environmental features whenever possible; and cooperative or networked approaches that use synergies of multiple entities to achieve a greater effect. Papers that illustrate modeling and application of control methodologies to micro systems are also of great interest.

**Session Chairs:** Dr. Rob Murphey, *AFRL/RWGN*;  
Sean Regisford, *AFRL/RBCA*



## ABSTRACT SUBMISSION:

### **Abstracts Due: July 31, 2009**

All abstracts submitted should be written for public release and submitted via the ION's website no later than July 31, 2009. Go to [www.ion.org](http://www.ion.org), click on Meetings then Abstract Submission for the appropriate event. Abstracts may also be e-mailed to [abstracts@ion.org](mailto:abstracts@ion.org) as a Microsoft Word or text file. Be sure to include your presentation title, the most appropriate session for your presentation, a list of all authors and affiliations, and the primary contact author's complete mailing address, phone, fax and e-mail. Abstracts should describe objectives, results, conclusions and the significance of your work.

Abstracts received electronically will be acknowledged electronically. Abstract title and corresponding primary author will also be posted weekly on the ION website. If your name does not appear after two weeks please call the Institute of Navigation National Office. Authors will be notified of acceptance in late September and sent an electronic author's kit with presentation guidelines.

Sessions are presentation only. Non-FOUO presentations will be made available to workshop attendees through the ION's web site. An electronic copy of the final workshop presentation with signed release form must be received by the ION National Office by October 30, 2009.

All presenters are required to pay workshop registration fees.

## LOCATION:

All workshop sessions will be held at the Emerald Coast Conference Center, 1250 Miracle Strip Parkway, SE, Fort Walton Beach, Florida, 32548.

**Hotel Reservations:** There are numerous hotels available in the area that provide government rated rooms.

## REGISTRATION INFORMATION: REGISTER ONLINE!

Go to [www.ion.org](http://www.ion.org) and follow the GNC Challenges for Miniature Autonomous Systems Workshop links to guide you through the registration process (available August 2009). Registration includes all sessions, refreshment breaks and on-line access to public release presentations that have been submitted by the author. Lunch is on your own.

	<u>ION Member Rates</u>	<u>Non-member Rates</u>
Registration Received and Paid by October 5	\$325	\$395
Registration Received or Paid after October 5	\$415	\$485

## FOUO SESSION REQUIREMENTS:

### **Attendance Requirements:**

Must meet all of the following:

- 1) U.S. Citizen
- 2) Visit Request/Authorization Request and Need-to-Know Statement
- 3) Photo ID
- 4) Workshop Participation Badge and payment of registration fees

### **Security Clearance:**

The FOUO sessions will be limited to U.S. citizens, DoD personnel and support contractors whose attendance is related to their position or program.

All visit requests must be received by October 5, 2009, and be approved by the AFRL/RW Security Office. For your convenience, a FOUO Visit Request Form can be found at [www.ion.org](http://www.ion.org) under the GNC Challenges for Miniature Autonomous Systems Workshop icon.

All non-government personnel must also complete a form DD 2345 which can also be [www.ion.org](http://www.ion.org) under the GNC Challenges for Miniature Autonomous Systems Workshop icon.

### **Fax All Visit Request and Need-to-Know Statements to:**

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