AIAA Guidance, Navigation, and Control Conference Call for Papers

AIAA Science and Technology Forum and Exposition (SciTech 2017)

DRAFT PAPER DEADLINE: 6 June 2016
SUBMISSIONS: http://www.aiaa-scitech.org

ORGANIZING COMMITTEE

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EVENT SYNOPSIS

The AIAA Guidance, Navigation, and Control Technical Committee is inviting participation in the 2017 AIAA Guidance, Navigation, and Control Conference. This conference is part of the AIAA Science and Technology Forum and Exposition (SciTech 2017), an event that will provide the world’s premier forum for presentation, discussion, and collaboration of science, research, and technology related to the aerospace industry. The AIAA Guidance, Navigation, and Control Conference is the largest forum dedicated to guidance, navigation and control (GN&C) serving the aerospace community. It brings together experts from industry, government, and academia on an international level to present and discuss all technical areas related to GN&C for aerospace applications.

A set of papers on a given topic may be proposed as an Invited Session or individual papers may be submitted to the technical areas listed below. Submission requirements for Invited Sessions and for submissions to individual technical areas are detailed below. Please read the submission requirements carefully as they do differ.
INVITED SESSIONS (PROPOSAL DEADLINE IS 17 APRIL 2016)

Invited session proposals are solicited in any of the topic areas listed below as well as in new or emerging technical areas. Papers in an invited session should form a cohesive focus on the relevant topic. Inclusion of a reasonable diversity of viewpoints is encouraged.

Procedure: The procedure for submitting an invited session proposal is different from the normal paper submission procedure. The invited session organizer will submit the entire session as a whole to BOTH the technical chair and co-chairs below by 17 April 2016. Invited session organizers should invite authors to participate, collect the required information, assemble the Session Proposal Packet, and submit the Session Proposal Packet as one file to the technical chair and co-chairs listed below.

Session Proposal Packet: The Session Proposal Packet should be submitted as a single document and include a one to two page Session Title and Summary Statement that describes the motivation and relevance of the proposed session. The document should have the session organizer contact information, along with details on each paper, including title, authors, author affiliation, and a few sentences describing the paper.

The technical chair and co-chairs will notify each organizer of the acceptance or rejection of their session by 13 May 2016.

Individual Paper Submission: Following the acceptance of an invited session, the individual extended abstracts for a session must be electronically submitted to the “Invited Session” area by the individual contributing authors. Extended abstracts should be at least 1000 words and must include sufficient detail to demonstrate the purpose of the paper, the technical foundation for the topics to be discussed, any preliminary results to date, and the expected results of the final paper, including key figures, equations, tables, and references, as appropriate. Sufficient information must be included in the submission to convince the technical chair and co-chairs and reviewers that the author(s) will have a strong likelihood of completing the final manuscript by the final manuscript submission deadline. The individual extended abstracts must be submitted by the conference abstract deadline of 6 June 2016, and final manuscripts are due 6 December 2016.

Authors of individual papers should send their paper tracking number to the organizer of their session.

Evaluation of Individual Papers: Please note that at the discretion of the Technical Program Committee, individual papers may be rejected and/or removed from proposed sessions and replaced by an appropriate contributed paper. Likewise, selected papers from rejected Invited Sessions may be placed into the regular program.

GN&C Invited Sessions Chair
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DRAFT MANUSCRIPT SUBMISSION GUIDELINES FOR GN&C TECHNICAL AREAS

Paper selection for non-invited sessions will be based on a full draft manuscript of the proposed technical paper. No exceptions will be made. Draft manuscripts and final papers must not exceed a total length of 25 pages. Each draft must begin with a 100- to 200-word abstract, and an introduction that includes a brief assessment of prior work by others and an explanation of the paper’s main contributions. The body of the manuscript must include sufficient detail to allow an informed evaluation of the paper.

TECHNICAL TOPICS

Papers covering all aspects of guidance, navigation, and control of aerospace systems may be submitted. Specifically, papers should describe novel analytical techniques, applications, and technological developments in areas such as: the guidance, navigation, and control of aircraft, spacecraft, missiles, robotics, and other aerospace systems; general aviation; in-flight system architecture and components; navigation and position location; sensors and data fusion; multidisciplinary control; and GN&C concepts in high-speed flight. Please refer to the following individual technical area descriptions to determine the topic that most closely aligns with your paper.

- Control Theory, Analysis, and Design
- Novel Navigation, Estimation, and Tracking Methods
- Aircraft Guidance, Navigation, and Control
- Spacecraft and Launch Guidance, Navigation, and Control
- Missile Guidance, Navigation, and Control
- Sensor Systems for Guidance, Navigation, and Control
- Mini/Micro Air Vehicle Guidance, Navigation, and Control
- Intelligent and Cooperative Control in Aerospace Applications
- Aerospace Robotics and Unmanned/Autonomous Systems

Please contact the GN&C Technical Area Chairs or Co-Chairs with questions.
The GN&C Technical Committee also sponsors a Graduate Student Paper Competition. Eligibility criteria and submission requirements are detailed here.

**Control Theory, Analysis, and Design**

Papers are sought that develop new theories, generate new algorithms, derive new analysis techniques or design tools, or modify and improve existing techniques for general application to control of aerospace vehicles. Topics of interest include robust control, nonlinear control, optimal control, multivariable control, adaptive and intelligent control, fault detection, redundancy management and bio-inspired control. Papers describing new analysis and synthesis techniques with illustrative realistic aerospace control examples are strongly encouraged. Papers discussing applications of existing control theoretic methods should be submitted to other technical areas that most closely matches the application. Examples of specific topics within the broad subject areas include:

- **Robust Control**: techniques for control design of systems with uncertainty; feedback stability, mu analysis and gain scheduling; multivariable stability margins and multiplier theory; mu-synthesis and H-infinity-optimal control.

- **Nonlinear Control**: techniques and methods for control of nonlinear models; Lyapunov techniques and their extensions; linear matrix inequalities; applications of nonlinear control methods, such as sliding mode or feedback linearization techniques.

- **Optimal Control**: optimization algorithms; objectives and issues in optimal control of nonlinear systems; dynamic programming; solution methods; case studies in analysis and design of optimal controllers for MIMO plants; robustness and stability margins; design tradeoffs.

- **Adaptive Control**: Model Reference Adaptive Control and variants, Lyapunov stability analysis of adaptive control laws; direct and indirect adaptive control for linear and nonlinear systems; computational challenges; adaptation rules; verification of margins for flight critical systems; models and learning rules in artificial neural networks; neural networks in system identification and control.

- **Fault Detection and Reconfiguration**: algorithms to detect sensor and effector faults; switchover control laws; simulations with fault injection and recovery performance.

- **Control Allocation**: control allocation laws including management of multiple effectors; verification and validation of redundancy management methods; implementation in real-time software.

- **Verification and Validation**: formal safety assurance techniques including model checking and theorem proving for studying complex aerospace systems; abstraction schemes; computational challenges; run-time assurance; implementation in real-time.
• **Other**: original theoretical contributions motivated from aerospace applications will also be considered.

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**GN&C Technical Area Co-Chair**
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**Novel Navigation, Estimation, and Tracking Methods**

Papers are sought that develop new theory, approaches, and applications associated with navigation, estimation, and tracking. Broad subject areas include estimation and navigation techniques; path planning; tracking methods. Examples of specific topics within the broad subject areas include:

- **Estimation**: parameter estimation; robust and adaptive filtering; nonlinear filtering and smoothing; nonlinear observers; distributed estimation; hybrid estimation; integrated estimation/control.

- **Navigation**: biologically-inspired navigation; vision-based navigation; X-ray source-based navigation; terrain-guided navigation; radio navigation; autonomous navigation and control (including integrated GPS and inertial navigation); simultaneous localization and mapping.

- **Path Planning**: path optimization; trajectory prediction; formation planning and determination.

- **Tracking**: nonlinear and multi-hypothesis tracking; data association; combined detection/tracking; sensor management; situational awareness; geolocation.

Papers that emphasize missions and systems should be submitted to the Aircraft, Spacecraft and Launch, Missile, or Mini/Micro Air Vehicle GN&C technical areas.

**GN&C Technical Area Chair**
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**GN&C Technical Area Co-Chair**
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Aircraft Guidance, Navigation, and Control

Papers are sought that address the development, simulation, and flight testing of GN&C systems for aircraft and helicopters. Papers that emphasize novel theoretical designs, including high-fidelity and detailed simulation/simulator results, and/or experimental results will be considered preferably. Areas of interest within the broad subject of aircraft guidance, navigation and flight control applications include:

- **Augmented Flight Control Systems**: stability and control augmentation; automatic flight path and speed control; auto pilot control; integrated guidance and control; trajectory generation and energy management; interdisciplinary flight control and vehicle performance; nonlinearities; structural control and vibration suppression; aeroservoelasticity; limitations of control effectors (e.g., saturation).

- **Fault Tolerance and Recovery Systems**: self-repairing or reconfigurable systems; situational awareness; command and decision support; flight envelope protection; trajectory recomputation and reconfiguration; fault detection and isolation.

- **Navigation and Flight Management Systems**: navigation algorithms; GNSS positioning; alternative navigation sensors; autonomous navigation; GPS performance and status; trajectory design; flight director design.

- **Flight Control Analysis and Flight Test Evaluation**: aircraft handling qualities; human-machine interface; pilot-in-the-loop; integrated vehicle ground testing; taxi testing; robustness and performance analysis on flight controlled systems.

- **Formation Flight Control with Uncertainties**: aircraft formation flight for drag savings; swarming, platooning, mobile sensor air networks; accommodation of atmospheric uncertainties on formation control.

**GN&C Technical Area Chair**
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Spacecraft and Launch Guidance, Navigation, and Control

Papers are sought that deal with topics specific to GN&C of launch, on-orbit flight and/or recovery of single or multiple space vehicles. Broad areas cover the design and challenges for on-orbit operations as well as mission studies for human exploration, unmanned missions, GN&C algorithms for ascent and entry, GN&C architecture and rapid prototyping, novel sensors, actuators and grappling mechanisms, multidisciplinary design and optimization. Areas of interest include:

- **Ascent, Entry, Descent & Landing GN&C**: ascent, rendezvous, on-orbit operations, entry, and landing as well as sensing systems for ascent, landing, rendezvous or deep space operations.

- **Reusable Vehicles**: Commercial Crew Integrated Capability (CCiCap), next-generation systems involving hypersonic entry vehicles (RLVs), or systems with reusable stages.

- **Attitude and Orbit Dynamics, Determination, and Control**: applications of attitude estimation and control; orbit estimation and control; momentum control, payload pointing and articulation; and GN&C and attitude determination and control software implementation for spaceflight use. Theoretical discussions should be supported by simulation, test, and/or flight performance data where possible.

- **Innovative Techniques to Improve Performance**: novel GN&C approach/techniques for space systems, applications involving existing sensors and actuators; new mission planning approaches that will reduce development cost; reduction of structural dynamic interaction or coupling between vehicle systems, GN&C actuation and disturbances; tolerance to failures in sensors, actuators, and structural integrity; tools and methods that support rapid trade space analysis for new vehicle concepts. Discussions on system-level error sources affecting GN&C functions are also encouraged.

- **GN&C Systems for Space Missions**: Earth and space science missions; unclassified topics concerning defense and surveillance satellites; International Space Station and its resupply and servicing vehicles; low-Earth-orbiting and geostationary communications satellites; small satellites; and GN&C consideration of future space systems. Papers presenting recent in-orbit experiences of GN&C and attitude determination and control systems are also solicited.

- **Spacecraft Formation Control**: formations; constellations; approach, rendezvous and docking; distributed aperture satellite formations.

- **Human Exploration Missions**: GN&C and targeting for NASA Human Spaceflight Exploration (MPCV, etc.); new capabilities required for manned asteroid, lunar, and Mars missions; ascent or entry flight phases on Earth (for the MPCV, SLS), the moon, asteroids, and other planets (for exploration missions).
• **Unmanned Missions**: Commercial Orbital Transportation Services (COTS)/Commercial Resupply Services (CRS), or general improved autonomy, capability, and reliability.

For papers that primarily focus on the sensor component of the GN&C problem, authors should submit to the Sensor Systems topic area. For papers that primarily focus on the robotics component of the GN&C problem, authors should submit to the Aerospace Robotics and Unmanned/Autonomous Systems technical area.

**GN&C Technical Area Chair**
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**GN&C Technical Area Co-Chair**
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**Missile Guidance, Navigation, and Control**

Papers are sought that relate to GN&C of missiles, launch vehicles, and reentry vehicles. Topics include design, analysis, simulation, and test of complete systems or subsystems. Examples of specific topics within the broad subject areas are:

• **Modern Autopilot/Guidance Approaches**: applications of modern robust and adaptive control algorithms to missile control, guidance, and integrated guidance and control.

• **Estimation and Filtering Algorithms**: novel approaches to estimation in missile applications, particularly for achieving high performance with lower fidelity sensors or multiple dissimilar sensors.

• **Trajectory Optimization**: design and analysis of control laws to achieve optimum trajectories for intercept guidance and reentry applications.

• **Computer-Based Design and Analysis Techniques**: advances in numerical guidance and control design and analysis methods including adjoint simulations.

• **Missile Applications**: GN&C designs for specific applications such as ship defense and national or theater missile defense systems.

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**GN&C Technical Area Co-Chair**
Julie Parish
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Sensor Systems for Guidance, Navigation, and Control

Papers are sought that describe novel stand-alone sensors, integrated sensor systems, and innovative sensing techniques for GN&C of surface, maritime, air, or space vehicles. Papers may address sensor systems for crewed or uncrewed vehicles. Papers describing innovative research, development, design, and integration work with illustrative GN&C sensor systems applications are highly encouraged. Examples of specific subjects within these broad areas include:

- **Sensor Design, Testing, and Performance Improvement**: testing and performance evaluation results from actual hardware; new GN&C sensor concepts; new techniques for designing, modeling, simulating, and prototyping sensors; sensor factory or in-situ calibration techniques; and fielding of sensor systems that support GN&C.

- **Miniaturization of Sensor Systems**: miniaturization of hardware and applications of relevant micro- and nanotechnologies; integrated sensor suites (e.g., sensor-on-chip, etc.).

- **Redundancy Management**: redundancy management of multiple sensors used by the onboard avionics systems; voting, selection, and tests; verification and validation of redundancy management schemes; implementation in real-time software.

- **Application Areas**: autonomous navigation in GPS-denied environments; novel inertial guidance and control sensors; mobile ad-hoc networks for swarming unmanned vehicles; networked sensors for vehicle control and navigation; computer vision for autonomous navigation, obstacle avoidance, collision avoidance and autonomous landing; and GN&C sensors in pointing, alignment, and robotic manufacturing applications.

Papers submitted to this area should primarily focus on the sensor component of the GN&C problem. Due to the broad application of sensor systems in GN&C, some papers may be better suited for presentation in application-specific technical areas such as Aircraft GN&C, Spacecraft GN&C, and Mini/Micro Air Vehicle GN&C. Please refer to individual technical area descriptions for further details and feel free to contact the GN&C Technical Area Chairs with questions on which area would be best for specific topics.

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**GN&C Technical Area Co-Chair**
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Mini/Micro Air Vehicle Guidance, Navigation, and Control

Papers are sought that address the challenges and missions associated with mini and micro air vehicles (MAVs—vehicles that are small enough to be human-portable). Fixed wing, rotary wing and flapping wing developments are all of interest. Main topic areas include:

- **New Designs/Capabilities**: new vehicle designs, and the interaction between the vehicle design and control synthesis process; sensor processing and control algorithms that enable autonomous perching and in-flight docking; atmospheric energy harvesting.

- **Sensors and Data Fusion**: state estimation algorithms suitable for implementation on MAVs; navigation in GPS denied environments; vision-based MAV autonomy.

- **Power Systems and Actuators**: high-voltage, low-current power conversion for piezoelectric actuators for MAVs; battery or fuel cell improvements.

- **Flight Dynamics and Control**: dynamic modeling of fixed, rotary and flapping wing MAVs; effects of realistic atmospheric conditions on modeling and flight control; flight control architectures for MAVs; bird and insect inspired flight.

- **Trajectory Planning**: planning algorithms suitable for implementation on MAVs; operation in constrained environments, near obstacles; effects of realistic atmospheric conditions on flight trajectories.

- **Experiments**: new empirical unsteady aerodynamic models; low Reynolds number aerodynamic force and moment characterization; identification of actuator and vehicle flight characteristics; fluid-structure interaction characterization and implications for control design.

Please note that papers dealing with multiple unmanned vehicles (large or mini/micro) should be directed to the Intelligent and Cooperative Control in Aerospace Applications technical area.

**GN&C Technical Area Chair**
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Intelligent and Cooperative Control in Aerospace Applications

Papers are sought that deal with the theory and application of all aspects of intelligent control of single vehicle, multi-vehicle and human-in-the-loop systems within aerospace GN&C. Papers are sought that present innovative developments; implementation and certification issues; planner, controller and estimator design; and intelligent and cooperative decision-making and control of autonomous agents, and mixed initiative control of semi-autonomous teams for a variety of aerospace applications.

• **Planner, Controller and Estimator Design**: planners, controllers and estimators designed using rule-based and model-based techniques, artificial neural networks, fuzzy logic, machine learning, reinforcement learning, evolutionary algorithms, and bio-inspired control techniques.

• **Cooperative Decision and Control of Autonomous Agents**: cooperative task assignment and trajectory optimization; biologically-inspired group behavior and control schemes.

• **Mixed Initiative Control of Semi-Autonomous Teams**: team auto-routing and coordinated rendezvous.

• **Cooperative Control with Uncertainty**: accommodation of effects of atmospheric and relative orbital drift effects on formations; noisy navigation or unreliable propulsion systems.

• **Applications**: intelligent control and estimation applications for aircraft, missiles, spacecraft, smart autonomous vehicles, mission-planning management, multi-objective control, system integration, fault detection, identification, and accommodation issues. Platforms include UAVs, Unmanned Combat Air Systems (UCAS), Unmanned Ground Vehicles (UGVs), Unmanned Underwater Vehicles (UUVs), Wide Area Search Munitions (WASMs), and satellite constellations and/or clusters.

Particular interests are in the stability and robustness of complex distributed control tasks, as well as in real-time implementation. Papers focusing on adaptive control theory should be submitted to the Control Theory, Analysis, and Design technical area.

**GN&C Technical Area Chair**  
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**GN&C Technical Area Co-Chair**  
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Aerospace Robotics and Unmanned/Autonomous Systems

This area includes GN&C design and challenges related to robotics and unmanned/autonomous systems, as well as research related to handling and operations. In particular, papers that relate to autonomous systems, such as: cooperative ground-based vehicles, UAVs, planetary rovers, and robotics for spacecraft servicing missions are welcome. Broad subject areas include: sensor/data fusion for navigation and perception; trajectory planning and tracking; and dynamical modeling and control of robotic vehicles and manipulators.

- **Sensor/Data Fusion**: sensor-based navigation, including simultaneous localization and mapping (SLAM) concepts; vision-based navigation systems using optical flow, occupancy grids, potential fields, and global and inertial navigation systems.

- **Trajectory Planning and Tracking**: methods of trajectory planning and tracking for single or multiple vehicles in uncertain environments, including optimal trajectory planning and probabilistic methods.

- **Dynamical Modeling and Control**: equations of motion for unique robotic or unmanned/autonomous vehicles or robotic manipulators, including the treatment of motion or dynamic constraints, and control challenges related to the dynamics of the vehicles or robotic manipulators.

Papers specifically related to the design and control of MAVs may be better suited in the Mini/Micro Air Vehicle GN&C technical area unless they have a strong robotics aspect; and, papers specifically related to distributed and cooperative control of multi-vehicle systems may be better suited in the Intelligent and Cooperative Control in Aerospace Applications technical area unless they have a strong robotics aspect.

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GN&C Graduate Student Paper Competition

The Guidance, Navigation and Control Technical Committee will host a Graduate Student Paper Competition at SciTech 2017. In addition to appropriate recognition, all finalists in the GN&C Graduate Student Paper Competition will receive a monetary award of $1,200. The overall winner will receive an additional $2,500 award.

For this competition, full draft manuscript papers are sought from graduate students on GN&C technical research topics, from which six finalists will be selected by a panel of judges for inclusion in a special GN&C Graduate Student Paper Competition session, which is typically held the Sunday evening prior to the conference.

Author eligibility and manuscript submission requirements are described below.

Eligibility Requirements

• A student must be the primary or sole author, enrolled at an institution of higher learning (any second author must be the graduate advisor; no more than two authors are permitted).
• The student author must be a member of AIAA in order to become a finalist in the competition.
• The student author must be a full-time graduate student in good academic standing at his or her university/institution at the time of submission.
• Manuscript content must represent the work of the student author.
• Full draft manuscript not exceeding a total length of 25 pages.
• The student author is not the overall winner of the preceding year’s competition.

Submission Requirements

• Graduate Student Paper Competition submissions must adhere to the overall Forum Abstract Submission Requirements.
• Students must select the “Student Paper Competition” presentation type during the electronic submission process. Do not submit the abstract more than once. Only submissions with “Student Paper Competition” presentation type indicated will be eligible for the competition.
• All submissions must be made by the Forum abstract submission deadline of 6 June 2016, 2000 hours Eastern Time Zone, USA.

Finalists will be required to make two presentations at the Forum: once in the appropriate regular technical session and once in a separate Graduate Student Paper Competition session. Note that authors will receive an accept/reject notification first for the regular conference review process and later for the graduate student paper competition. A paper can be (1) accepted for both the regular conference and competition, (2) accepted to the regular conference, but not the competition, or (3) not accepted to either the regular conference or the competition.
Specific questions should be referred to: Julie Parish, Kimberly Hinson or Joseph Connolly.

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