

***National Research Council***

***- Committee on -***

***Autonomy Research for Civil  
Aviation***

***Overview and Summary of Activities***

***10 October 2013***

# STATEMENT OF TASK

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- ***Develop a National Research Agenda for Autonomy in Civil Aviation***
  - Prioritized set of integrated and comprehensive technical goals and objectives
  - ... of importance to the civil aeronautics community and the nation
- ***Consider***
  - current state of the art in autonomy research and applications, including non-aviation sources
  - current national guidance on research goals and objectives
- ***Describe***
  - forms and applications of autonomy reviewed
  - potential contributions of autonomy to civil aviation ... evolved and ‘game-changers’ ... with a 10-20 year focus
  - technical and policy barriers to operational systems and implementation
  - key challenges and gaps to be addressed by a national research agenda for autonomy in civil aviation
- ***Outline***
  - a prioritized set of research projects that
    - enable development of CONOPS
    - lead to development, integration, testing and demonstration
    - predict system-level effects to the NAS
    - define approaches to verification & validation ... and certification
  - The outline should be developed with due consideration of required resources and organizational partnerships, and it should describe potential contributions and roles of U.S. research organizations

# PARTICIPANTS

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- **Dr. John-Paul B. Clarke, Co-Chair**, Associate Professor of Aerospace Engineering, Georgia Institute of Technology
- **Dr. John Lauber, Co-Chair**, Private Consultant, (former NTSB)
- **Mr. Alan Angleman**, NRC, Study Director
- **Dr. Brent Appleby**, Deputy to the Vice President Engineering for S&T, C.S. Draper Laboratory
- **Dr. Ella Atkins**, Associate Professor, Department of Aerospace Engineering, University of Michigan
- **Mr. Anthony Broderick**, Consultant (former FAA)
- **Mr. Gary Cowger, Chairman & CEO, GLC Ventures, LLC**
- **CAPT Noah Flood**, Delta Airlines
- **Dr. Michael S. Francis**, Chief, Advanced Programs and Senior Fellow, United Technologies Research Center
- **Dr. Eric Frew**, Associate Professor & Director, Research & Engineering Center for Unmanned Vehicles, University of Colorado
- **Dr. Andrew Lacher**, Senior Principal, UAS Integration Research Leadership, The MITRE Corporation
- **Dr. John Lee**, Emerson Electric Professor, Department of Industrial and Systems Engineering, University of Wisconsin
- **Dr. Kenneth M. Rosen**, President, General Aero-Science Consultants, LLC
- **Dr. Lael Rudd**, Autonomy Development Lead, Northrop Grumman Aerospace Systems
- **Dr. Trish Ververs**, Engineer Fellow, Honeywell Aerospace
- **Mr. Larrell Walters**, Head of the Sensor Systems Division, University of Dayton Research Institute
- **Dr. David Woods**, Professor, Institute for Ergonomics, The Ohio State University
- **Dr. Edward L. Wright**, David Saxon Presidential Chair, Department of Physics and Astronomy, University of California, Los Angeles

# STUDY PLAN

- Interviews and presentations to study team
  - NASA (sponsor) perspective ... and current program overview
  - Aviation issues
  - Autonomy & other related relevant technologies (e.g. robotics, communications, ...)
  - Non-aviation applications of autonomy and implications (e.g. automotive, space, ...)
  - Policy perspectives
  - Other issues/factors that influence the agenda
- Schedule ... 4 meetings
  - July 10-12 Washington, DC
  - August 27-29 Irvine, CA
  - November 13-14 Washington, DC
  - December 16-18 Irvine, CA (Closed meeting)
- Deliberate, discuss, integrate, adjudicate, achieve consensus ...
- Prepare study report for NRC release

# 1ST MEETING OVERVIEW

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- Keck Center, Washington, DC ... July 10-12, 2013
- Introductory Comments (Chairs, NRC) ... Participant Introductions
- Open sessions (Presentations)
  - NASA ARMD Perspective ... Shin, Irvine, Pearce, Cavalowsky, Rohn, Waggoner
  - NASA Programs
    - Autonomy-related research ... C Moore, NASA HQ, Advanced Space Exploration
    - Autonomy-related research ... Dr. M Schwabacher, NASA STMD Autonomous Systems
  - Roadmap for US Robotics ... H Christensen, Georgia Tech
  - FAA Perspectives on Autonomy ... K Abbott, FAA Flight Deck Human Factors & B Kiliardos, Next Gen Human Factors Integration
  - DSB Task Force – “Role of Autonomy in DOD Systems” ... B Appleby, Draper Labs
  - Perspectives on Autonomy Research ... D Mindell, MIT
  - Perspectives on Autonomy Research...K Arthur, Aviation Dev’t Directorate, Ft Eustis
  - Drones – A Tipping Point in Technology ... M Cummings, MIT/Duke
  - Closed Loop Autonomous Control – Outer/Inner Space, K Rajan, Monterey Bay Aquarium Research Institute
  - Perspectives on Autonomy Research, AF Research Lab ... J Overholt, K Kearns, Human Effectiveness Directorate
- Closed session

# 2nd MEETING OVERVIEW

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- Beckman Center, Irvine, CA August 27-29, 2013
- Open sessions (Presentations)
  - Perspective of NAC UAS Subcommittee Chair...Langford, Aurora Flight Sciences
  - Challenges and barriers to UAS Integration into the NAS...Monk, CSSI, Inc.
  - Autonomy and AI in Space Exploration...Chien, JPL
  - Perspectives on autonomy in ground vehicles...Bishop, Bishop Consulting
  - Perspective on cybersecurity, vehicle assurance, IT for autonomous systems...Johnson, Honeywell
  - AFRL work on V&V...Clark and Smith, Autonomous Control Branch, AFRL
  - Ethical, Legal and Public Perception/Policy issues...Wallach, Yale and Walker Smith, Stanford University
  - Systems Architecture for Autonomous Systems...Vos, Athena Technologies
  - Autonomous Systems for Ground Vehicles...Nass & Storke, Stanford University
  - Robotics and Autonomous Systems...Hebert, Mellon University
  - Control and Dynamical Networked Systems for Autonomy...Murray, Caltech
  - FAA Perspective on UAS...Williams, FAA
  - Developments from Open Source UAV community...Anderson, 3DRobotics
  - AutoMax Overview and Update...Kopardekar & Alexandrov, NASA LaRC
- Closed session (Committee discussions)

# FUTURE SPEAKERS

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- Vic Riley, Boeing, Cockpit systems (confirmed)
- Nat Beuse and Tim Johnson, NHTSA (confirmed)
- Young Kim, Bosh Agriculture (confirmed)
- Terry Fogarty, K-MAX program (invited)
- Patricia Gruber, Battelle, Navy concepts of operations (confirmed)

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# DISCUSSION