Michigan-AFRL Collaborative Center in Control Science
MACCCS (MAX)

Anouck Girard
University of Michigan, PI

Carlos Cesnik, James Driscoll, Pierre Kabamba (UM)
Anuradha Annaswamy, Emilio Frazzoli (MIT)
XinYan Deng (Purdue)
September 19, 2012
Michigan/AFRL Collaborative Center in Control Science (MACCCS, or MAX)

• An ongoing partnership between:
  – The University of Michigan, Ann Arbor
  – The Massachusetts Institute of Technology,
  – Purdue University and
  – The Control Science Center of Excellence in the Air Force Research Laboratory’s Air Vehicles Directorate

• Research foci:
  – Modeling and control of hypersonic vehicles
  – Cooperative control of unmanned air vehicles
MAX 2.0 Center Team

• Center team:
  – Anouck Girard (UM, PI)
  – Carlos Cesnik (UM)
  – James Driscoll (UM)
  – Pierre Kabamba (UM)
  – Anuradha Annaswamy (MIT)
  – Emilio Frazzoli (MIT)
  – XinYan Deng (Purdue)

AFRL Center of Excellence Team
UAV Team Lead: Corey Schumacher
HSV Team Lead: Michael Bolender
FWMAV Team Lead: Michael Oppenheimer
Hypersonic Vehicles

• Operability limits, controllability and uncertainty input to an adaptive control model of hypersonic vehicles

• Adaptive control of hypersonic vehicles
Cooperative Control of Unmanned Air Vehicles

- Supervision and control for collaborative heterogeneous systems
  - Mixed-initiative operations

- Dynamic mission planning
  - Provably efficient, scalable and robust

- Flapping wing micro air vehicles
Center Highlights

- **Numbers**: 30 students (18 PhD, 11 MS), 6 post-docs, 1 visiting professor and 9 faculty supported
- **31 peer reviewed journal articles, 100 conference papers, 3 book chapters (over 5 years)**
- **Year 5**: at least 5 journal, 19 conference papers so far (published or accepted)
- **Major releases of models and algorithms to the AF, other government entities, industry, and research**: MASIV, MASTRIM, RRT* libraries, ROM methodologies for unsteady aerodynamics and thermoelastic analysis, flight dynamics code with aerothermoelastic effects
- **Honors**: four faculty promotions (Frazzoli, Cummings, Girard, Cesnik), one fellow of AIAA (Cesnik), three MAX post-docs or PhDs have accepted faculty positions (Karaman, Pavone, Savla), Best Open Source Code Award (RSS, Frazzoli and Karaman), AIAA best grad presentation award (Torrez), Best paper award, Control Systems Magazine (Annaswamy).
Collaboration Plan

- Regular visits, including summer visits
- Formal yearly reviews
- Student-run 6-month reviews
- Seminar series
  - Control and Aero Seminars at UM and MIT
- Scientist in residence
- Foreign-national post-doctoral researchers and graduate students travel to various universities
Agenda for the Review

• **Day 1: Wednesday, September 19th**
  - 8:00 am – 8:15 am - Welcome Doman
  - 8:15 am – 8:30 am - Center Overview Girard
  - 8:30 – 12:10 am - UAV Cooperative Control – Overview and Technical Topics
  - 8:30 am – 9:00 am - Kingston
  - 9:00 am – 10:00 am - Girard
  - 10:00 am – 10:20 am - Kabamba
  - 10:20 am – 10:40 am - BREAK
  - 10:40 am – 11:40 am - Frazzoli
  - 11:40 am – 12:10 noon - Deng
  - 12:10 noon – 12:30 pm - Board Reflection Time
Agenda for the Review

- **Day 1: Wednesday, September 19**
  - 12:30 pm – 1:30 pm LUNCH
  - 1:30 pm – 4:30 pm - Hypersonic Vehicles Modeling – Overview and Technical Topics
  - 1:30 pm – 2:00 pm - Doman
  - 2:00 pm – 3:00 pm - Driscoll
  - 3:00 pm – 3:30 pm - BREAK
  - 3:30 pm – 4:00 pm - Cesnik
  - 4:00 pm – 4:30 pm - Annaswamy
  - 4:30 pm - 4:45 pm Board Reflection Time
Agenda for the Review

• **Day 2: Wednesday, September 20th**
  – 8:00 am - Coffee
  – 8:30 am – 11:00 am - Executive board panel discussion (closed)
  – 11:00 am – 12:00 pm - Executive board panel feedback to steering committee
  – 12:00 Noon - Adjourn