The UTIAS Flight Systems and Control Research Group and Laboratory

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Research Interests & Mission

Aircraft Systems
Modeling and Simulation
Control and Integration
Testing and Verification
automation, optimization, integration, coordination

Recent Research Projects
- Aircraft vapor cycle system (2005–now)
- Cooperative Control of flying wings (2005–now)
- Synchronized Control and applications (2003–now)
- Flight dynamics and control in MDO (2002–now)
- Control of UAVs and HIL simulation (2003-04)
- Integrated Multi-objective control (2001-05)
- Aircraft WAIS Modeling and Simulation (2001-03)
- Robust Flight Control, RT Investigation (2000-02)

F-18A Close-Formation Control
- Formation (coupling aerodynamics) dynamics model development
- Motion synchronization control to improve formation performance

J. Shan and H.H.T. Liu, AIAA JGCD, Vol. 28, No. 6, 2005
Motion Synchronization of 3DOF Helicopters Control

- Generic synchronization strategy to improve transient coordination performance

\[ E(t) = [e_1(t), e_2(t), \ldots, e_n(t)]^T \]
\[ \dot{e}_k(t) = \Delta \theta_k(t) - \omega(t) \]
\[ u_k(t) = \theta_k(t) - \hat{\theta}_k(t) \]


UAV Control

- UAV Control, Hardware-in-the-loop simulation, real-time simulation, flight testing

J. Shan and H.H.T. Liu, ACC 2006

Interactive Control and Simulation Platform Development

- Interactive and integrated platform to allow for “connect-and-play” development strategy

IOS acts as a Gateway for the FSC network, forwarding selected incoming packets to the model computer.

Controls (wind)

State Model computer

Built-in autopilot commands are overwritten with controller, implemented in Matlab/Simulink, running on any computer inside the FSC network.

Uses information about current state to calculate appropriate control commands.

Images courtesy of Mechtronix Systems Inc.

Multi-objective Control and Optimization for Integrated System

- Uniform parameterization method to address control and structure design

Successful implementation on integrated flight/propulsion control and helicopter experimental demonstration

Flight Dynamics and Control in MDO

- Integrated aircraft conceptual design including flight dynamics and control
- Multidisciplinary optimization design (MDO) applications
- Aircraft design toolbox development


Aircraft Wing Anti-Icing System Modeling, Control and Simulation

- Thermodynamic modeling (CFD)
- System identification model for control and simulation

J. Hua and H. H. T. Liu, AIAA JAC, Vol. 40, 2004

Robust Flight Control: Real-Time Simulation Investigation

- Robust flight control implementation and real-time simulation

D. Harman and H. H. T. Liu, CASJ, Vol. 49, 2005

Decentralized Flight Performance Control Integration

- Decentralized flight control
- Systems integration and performance evaluation

H. H. T. Liu, CJS, Vol. 35, No. 3, 2005
Some Numbers to Count

- Publications (2000-06)
  - Refereed Journal Papers: 15
  - Refereed Conference Papers: 44
- Laboratory Facilities (3)
- Graduate Students - 10
  - Ph.D. (2) - 1 graduated
  - M.A.Sc. (7) - 4 graduated
  - M.Eng. (1)
- Undergraduate Students - 23
  - 4th-year thesis students (9)
  - summer students (8)
  - International interns (4) - Germany and Netherland
- Intellectual Property
  - 1 IP (invention) disclosure
  - 1 U.S. patent - pending

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- Mr. Ruben Perez (Ph.D. Candidate)
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Flight Systems and Control

Thank You

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