Georgia Tech Air Transportation Laboratory

Overview of the Air Transportation Laboratory

18 May 2010

Overview

Mission

Motivation

People

Advisors

Research Projects

ATL Mission

Enable the future of air transportation by simultaneously…

- Maximizing efficiency
- Maximizing positive societal impact
- Minimize negative societal impact (especially on the environment)

Through innovations in…

- Control
- Human Factors
- Optimization
- System Analysis and Design

ATL Mission (alternate definition)

Creating the future…

- one algorithm
- one airline schedule
- one flight procedure

at a time by…

- Combining theory and practice
- Accelerating industry adoption
- Training future industry thought-leaders
- Training next generation of researchers

ATL Motivation

Air transportation in the School of Aerospace Engineering (AE)

- Critical mass recently created in air transportation
  - Through hires (Clarke, Feigh, Feron) and transfers (Pritchett)
- Opportunity to address the “entire system”
  - Interactions between vehicle design and system design and operations

Air transportation related courses and research in other schools

- Industrial and Systems Engineering (ISyE)
  - Airline scheduling and in large-scale optimization
- Electrical and Computer Engineering (ECE)
  - Game theory
- Mechanical Engineering (ME)
  - Modeling and open-loop control
- Civil and Environmental Engineering
  - Demand modeling

Opportunity to create focused initiative across Institute

ATL People

Faculty

- Barnes (Morgan State University)
- John-Paul Clarke (AE)
  - Director
- Ozlem Ergun (ISyE)
- Karen Feigh (AE)
- Eric Feron (AE)
- Laurie Garrow (CEE)
- Ellis Johnson (ISyE)
- Amy Pritchett (AE)
- Jeff Shamma (ECE)
- William Singhose (ME)
- Senay Solak (U Mass Amherst)

Research Engineers

- Jim Brooks (AE)
- Hui-Han Chang Chien (AE)
- Atri Dutta (AE)
- Leihong Li (AE)
- Terran Melconian (AE)
- Liling Ren (AE)
- Erwan Salaün (AE)

ATL People

Graduate Students

- Su Won Bae
- Pierrick Burgain
- Yu-Heng Chang
- Bethany Davis
- Matt Elliot
- Maxime Gariel
- Brian Kim
- Sang-Hyun Kim
- Evan McClain
- Jon Petersen
- Vlad Popescu
- Isaac Robeson
- Gustav Söveling
- Adan Vela
- Jeb Watson
- Yan Shu
- Clayton Tino

Undergraduate Students

- Abigail Diocares
- Partick Eden
- Andrew Mahon
- Jong Wook Park
- Robert Schlein
- Lawrence Wong

ATL People

Graduate Alumni/ae

- Marcus Lowther (Metron)
- Gaurav Nagle (Sensis)
- Senay Solak (U Mass Amherst)
- Heinrich Souza (UK)

Undergraduate Alumni/ae

- Abhizna Butchibabu (MIT)
- Sathya Silva (NASA)
- Dilip Thekkoodan (NUS)

ATL Advisors

Cynthia Barnhart
- Associate Dean of Engineering
- MIT

Thierry Beauvais
- Technical Director
- Thales Air Systems Division

Carl Burleson
- Director Office of Environment and Energy
- FAA

Michael Clarke
- Director of Optimization Solutions
- Sabre Airline Solutions

Seymour Douglas
- Executive Director Analytics
- Cox Communications

Hugo Resende
- Senior Manager Marketing Strategy (formerly Chief Scientist)
- Embraer

Scott Simcox
- CEO
- ATAC Corporation

Barry Smith
- Executive Vice-President and Chief Scientist
- Sabre-Holdings (retired)

Neil Stronach
- Senior Vice-President System Operations
- Delta Air Lines

Karlin Toner
- Director
- Joint Planning and Development Office

ATL Research Projects - Current

Surface Operations (1)

- Collaborative Decision Making (CDM)
  - Sponsor:
    - Thales
  - Objective(s):
    - Analyze and develop models for airport surface operations
    - Identify opportunities for technology insertion
  - ATL Investigator(s):
    - Feron (PI), Clarke
- Surface Traffic Optimization in the Presence of Uncertainties
  - Sponsor:
    - NASA
  - Objective(s):
    - Characterize the constraints and uncertainties that affect surface traffic operations
    - Develop optimization strategies, architectures, and algorithms that are robust to uncertainties
    - Define a set of scenarios for the evaluation of the optimization algorithms and strategies
    - Conduct numerical experiments to quantify the performance of the algorithms and strategies
  - ATL Investigator(s):
    - Clarke (PI), Feron, Johnson, Li (Project Manager)
  - External Collaborator(s):
    - Balakrishnan (MIT); Rappaport (Sensis); Solak (U Mass Amherst)

ATL Research Projects - Current (Cont'd)

Surface Operations (2)

- Modeling Environmental Factors in Surface Traffic Optimization (MEFISTO)
  - Sponsor:
    - NASA (subcontractor to Metron Aviation)
  - Objective(s):
    - Provide a unifying approach and supporting tools for making environmental constraints an integral part of the design of airportal concepts
    - Extend real-time algorithms that enable interaction of planning algorithms concerned with different aspects of the surface-optimization problem (safety, efficiency, and environmental impacts)
    - Provide a deeper understanding of the benefits that could be achieved in emissions, noise, and fuel efficiency as NGATS enables increases in capacity (and likely traffic levels) via new technology and re-designed airportals
  - ATL Investigator(s):
    - Clarke (PI), Li (Project Manager)
  - External Collaborator(s):
    - Thompson (Metron); Sherry (George Mason)

ATL Research Projects - Current (Cont'd)

Terminal Area Operations (1)

- Continuous Descent Arrival (CDA)
  - Sponsor:
    - FAA PARTNER
  - Objective(s):
    - Develop algorithms and tools for optimizing the vertical profile and spacing of RNAV/RNP arrivals
    - Conduct flight evaluation tests at airports (e.g. ATL)
    - Support implementation of permanent procedures (e.g. LAX)
  - ATL Investigator(s):
    - Clarke (PI), Brooks (Project Manager), Ren
  - External Collaborator(s)
    - Boyce (Delta)
    - Allerdice, Chambers, Purefoy, White, Zondervan (FAA)

ATL Research Projects - Current (Cont'd)

Terminal Area Operations (2)

- Characterization of and Concepts for Metroplex Operations
  - Sponsor:
    - NASA
  - Objective(s):
    - Identify the dependencies and interactions between metroplex airports
    - Develop a classification scheme for metroplex dependencies
    - Determine the impact of NGATS concepts and capabilities on metroplex operations
    - Investigate new and innovative methods for increasing metroplex capacity
  - ATL Investigator(s):
    - Clarke (PI), Ren (Project Manager)
  - External Collaborator(s):
    - Crisp, den Braven, Gutterud (ATAC)
    - Cross, Lewis, Sliney, Thompson (Metron)
    - Saraf, Schleicher, Timar (Sensis)

ATL Research Projects - Current (Cont'd)

En Route Operations (1)

- NextGen En Route Traffic Optimization
  - Sponsor:
    - FAA PARTNER
  - Objective(s):
    - Develop algorithms and tools for determining the trajectory changes that minimize the fuel and emissions required to resolve conflicts while meeting require time of arrival constraints
    - Develop decision support tool based on algorithms and evaluate their performance through human-in-the-loop studies
  - ATL Investigator(s):
    - Clarke (PI), Feigh (co-PI), Dutta (Project Manager), Feron,Johnson
    - Crisp (ATAC)
    - Altus (Jeppesen)
    - Thompson (Metron)

ATL Research Projects - Current (Cont'd)

En Route Operations (2)

- Objective Measures of Airspace Complexity to Support Airspace Management
  - Sponsor:
    - FAA PARTNER
  - Objective(s):
    - Measures of airspace complexity suitable for real-time decision aiding and airspace planning
  - ATL Investigator(s):
    - Clarke (PI), Feron, Salaün (Project Manager)
- Graceful Degradation of Advanced Air Traffic Control Systems
  - Sponsor:
    - Thales
  - Objective(s):
    - Analyze and develop models for en route and terminal area operations during component failure
    - Identify opportunities for technology insertion
  - ATL Investigator(s):
    - Feron (PI), Clarke

ATL Research Projects - Current (Cont'd)

En Route Operations (3)

- Influence of Degraded Environment on Airspace Safety (IDEAS)
  - Sponsor:
    - NASA Ames
  - Objective(s):
    - Evaluate the health and safety of current and projected National Airspace System traffic against environmental degradations
    - Develop an effective health monitoring system for the air transportation system that may be used in current and future concepts of operations
  - ATL Investigator(s):
    - Feron (PI), Clarke
  - External Collaborator(s):
    - Emilio Frazzoli (MIT)

ATL Research Projects - Current (Cont'd)

Airline Schedule Planning

- Fractional Ownership Aircraft and Crew Scheduling
  - Sponsor:
    - CitationShares
  - Objective(s):
    - Develop algorithms and tools for the scheduling of aircraft and crew in a fractional ownership
  - ATL Investigator(s):
    - Johnson (PI), Ergun
- Robust Scheduling
  - Sponsor:
    - --
  - Objective(s):
    - Develop algorithms and tools for creating airline schedule that are robust to disruptions
  - ATL Investigator(s):
    - Clarke, Johnson

ATL Research Projects - Current (Cont'd)

Airline Schedule Planning (2)

- Optimal Airport Terminal Configuration and Gating
  - Sponsor:
    - --
  - Objective(s):
    - Develop algorithms and tools for determining optimal layout of airport concourses and aircraft gate assignments considering both passenger connection and security considerations
  - ATL Investigator(s):
    - Clarke, Johnson

ATL Research Projects - Current (cont'd)

Airline Operations and Recovery

- Integrated Recovery
  - Sponsor:
    - Sabre
  - Objective(s):
    - Develop optimization algorithms for integrated recovery (simultaneous recovery decision-making)
  - ATL Investigator(s):
    - Johnson (PI), Clarke