

Adan E. Vela

EDUCATION	<p>Georgia Institute of Technology, Mechanical Engineering, Ph.D. Stanford University, Mechanical Engineering, M.S. University of California, Berkeley, Mechanical Engineering, B.S.</p>
RESEARCH INTERESTS	Air transportation systems, applied optimization, human-factors and human-centric control and decision-support systems.
HONORS AND AWARDS	<p>Best in Session, DASC2012 Best in Session and Best in Track, DASC2011 Best in Session, ACC2011 1st Place, Best Graduate Student Paper, DASC2010 2nd Place, Best Graduate Student Paper, DASC2009 Best in Session, DASC2009 Presidential Fellowship, Georgia Institute of Technology Guezqueta Fellowship, Georgia Institute of Technology Stanford 3D Fellowship, Stanford University Honors Distinction, National Science Foundation Graduate Fellowship 2nd Place, National Academic Olympiad, 2003 NTCC-SHPE Drake Scholarship, University of California, Berkeley (ME Dept) Luckenback Briggs Scholarship, University of California, Berkeley Chancellor's Scholarship, University of California, Berkeley</p>
PROFESSIONAL EXPERIENCE	<p>MIT Lincoln Laboratory <i>Technical Staff: Homeland Protection & Air Traffic Control</i> 2012-2016 Specializing in modeling, simulating, analyzing, and optimizing air transportation systems. Efforts span aircraft models that consider both human-control and aircraft dynamics to agent-based simulations of airports and airlift networks. Work also includes leading the optimization process for tuning the next generation collision avoidance system to function efficiently under closely spaced parallel operations. Additionally, conducting research in safety and risk-based modeling for concept development and validation of next generation air transportation system improvements. Recent work efforts include evaluating the aviation safety of small UAV.</p> <p>Georgia Institute of Technology <i>Graduate Researcher: Air Transportation Laboratory</i> 2006-2011 Researched air transportation systems by means of a control-theoretic framework. Initially Ph.D. research focused on conflict resolution and capacity estimation problems. Ultimately, work led to developing analytical methods towards understanding and estimating airspace capacity for both nominal and perturbed conditions, with a strong focus on human-factors issues.</p> <p><i>Faculty Advisors:</i> John-Paul Clarke, Eric Feron, William Singhose <i>Dissertation Title:</i> Understanding Conflict-Resolution Taskload: Implementing Advisory Conflict-Detection and Resolution Algorithms in an Airspace</p> <p>École Nationale de l'Aviation Civile <i>Visiting Researcher</i> Fall 2008 Researched conflict resolution algorithms for air traffic control consistent with NextGen</p>

systems and 4D trajectory planning. Developed a model that considers adjustment of speed profiles, requested arrival times, and flight-level assignments of aircraft to provide safe passage through an airspace. Special attention was taken to ensure the algorithm to be controller-centric; it resolves as many conflicts as possible through straight-forward, possibly automated means, while segregating more complex conflicts for the attention of controllers. Approach focused on understanding dimensional reduction of the solution space to be consistent with operations. Funding provided by the National Science Foundation through a proposal submitted to the Doctoral Dissertation Enhancement Projects program.

Stanford University

Graduate Researcher: Hybrid Systems Control Laboratory **2004-2006**

Researched decentralized optimization algorithms for path planning of airplane formations in which individual agents act as local decision-makers and optimize local costs while coordinating with each other through constraints. In applying such a decentralized scheme, computation costs are spread over a larger network providing robustness and scalability as the system grows.

University of California, Berkeley

Undergraduate Researcher: Mechanical Systems Control Laboratory **2002-2003**

Constructed a robotic inchworm and developed the required control algorithm for locomotion. As part of a research team constructed and implemented a 3-Link inchworm-like robot designed to walk forward by alternating contracting and expanding motions of its triangular body while holding one foot in place.

Researched and modeled the control of point contact pushing of large objects with a 2-DOF manipulator as a nonholonomic system utilizing Matlab and Simulink.

Georgia Institute of Technology

NSF Research Fellow, Automation and Mechatronics Research Group **Summer 2003**

Programmed and simulated Input Shaping within an obstacle avoidance feedback loop to reduce vibrations in movable flexible systems.

University of Maryland, College Park

NSF Research Fellow, Maryland MEMS Lab **Summer 2001**

Composed and developed rapid reproduction processes for the thermal embossing of polymer micro-fluidic devices from silicon masters. Studied geometric limitations on reservoirs embedded on the same surface as the microchannels resulting from the thermal bonding process to seal channels.

ACADEMIC
EXPERIENCE

Georgia Institute of Technology

Teaching Assistant: Mechanical Engineering **Spring, 2010**

Served as a Teaching Assistant for ME3015 (System Dynamics and Controls). Held office hours and problem solving sessions, and assisted in the assignment and grading of homework and exams.

CAHSEE, Washington, DC

Instructor: Descriptive Geometry, Physics

Summer, 2004 & 2005

Participated in an intensive summer academic program geared for talented underrepresented minority youth. Designed and taught 5-week courses on Descriptive Geometry and Physics. The program included a 2-week academic and leadership-training program in Washington D.C.

Stanford University

Teaching Assistant: Computational and Mathematical Engineering

Spring, 2006

Served as a Teaching Assistant for CME106 (Probability and Statistics). Conducted discussion and problem solving section, graded assignments and exams.

University of California, Berkeley

Teaching Assistant: Mechanical Engineering

Fall, 2003

Assisted students in laboratory work, primarily with design and implementation of robotics projects.

TECHNICAL REPORTS

“Terminal Flight Data Manager (TFDM): Runway Balancing Capability Assessment”, Vela, Sanberg, Reynolds. Project Report ATC-421, MIT Lincoln Laboratory, 2014.

“Review of STPA Method and Results to Support NextGen Concept Assessment and Validation”, Harkleroad, Vela, Kuchar. Project Report ATC-427, MIT Lincoln Laboratory, 2013.

“Risk-Based Modeling to Support NextGen Concept Assessment and Validation”, Harkleroad, Vela, Kuchar, Barnett, Merchonet-Bennett. Project Report ATC-405, MIT Lincoln Laboratory, 2013.

“Understanding Conflict-Resolution Taskload: Implementing Advisory Conflict-Detection and Resolution Algorithms in an Airspace”, Vela. *Ph.D. Thesis*, Georgia Institute of Technology, 2011.

JOURNAL PUBLICATIONS

“Optimizing a Collision-Avoidance System for Closely Spaced Parallel Operations”, Smith, Vela, Kochenderfer, Olson. *AIAA Journal of Aerospace Information Systems*, 2015.

“Data-based Modeling and Optimization of En-route Traffic,” Marzuoli, Gariel, Vela, Feron. *AIAA Journal of Guidance, Control, and Dynamics*, 2014.

“Determining Stochastic Airspace Capacity for Traffic Flow Management,” Clarke, Solak, Ren, Chen, Vela. *Transportation Science*, 2012.

“Formulation of Reduced Taskload Optimization Models for Conflict Resolution,” Vela, Feigh, Solak, Singhose, Clarke. *IEEE Transactions on Systems, Man, and Cybernetics, Part A: Systems and Humans*, 2012.

“Aircraft Proximity Maps Based on Data-Driven Flow Modeling”, Salaun, Gariel, Vela, Feron. *AIAA Journal of Guidance, Control, and Dynamics*, 2012.

“Near Real-Time Fuel Optimal En Route Conflict Resolution,” Vela, Solak, Clarke, Singhose, Barnes, Johnson. *IEEE Transactions on Intelligent Transportation Systems*, 2010.

“Generating robust and flexible operational airlift schedules using stochastic simulation-based and schedule comparison measures”, Hussain, et al. Military Operations Research Society Symposium, 2016.

“Evaluation of Strategic and Tactical Runway Balancing”, Vela, Sandberg, Reynolds. USA/Europe Seminar on Air Traffic Management Research & Development, 2015.

“Collision Avoidance System Optimization for Closely Space Parallel Operations through Surrogate Modeling”, Smith, Vela, Kochenderfer, Olson. AIAA Guidance, Navigation, and Control Conference, 2013.

“A posteriori Aircraft Control Signal Recovery via Sparsity-Inducing Norm Minimization”, Vela, Vela, Karasev. Digital Avionics Systems Conference, 2012.

“Analysis of Airspace Degradation and Optimization of En-route Traffic under Degraded Conditions”, Marzuoli, Feron, Vela. Digital Avionics Systems Conference, 2012.

“Detection of Human-Initiated Vehicle Maneuvers via Group-Sparsity”, Karasev, Vela, Vela, Tannenbaum. International Symposium on Mathematical Theory of Networks and Systems, 2012.

“The Relative Value of Trajectory Prediction and Conflict-Resolution Algorithms”, Vela, Clarke, Feron, Singhose. Digital Avionics Systems Conference, 2011.

“Air Traffic Optimization on a Data-Driven Network Flow Model”, Marzuoli, Gariel, Vela, Feron. Digital Avionics Systems Conference, 2011.

“Determining the Value of Information for Minimizing Controller Taskload: A Graph-Based Approach”, Vela, Clarke, Durand, Feron, Singhose. USA/Europe Seminar on Air Traffic Management Research & Development, 2011.

“Bounds on Controller Taskload Rates at an Intersection for Dense Traffic,” Vela, Salaun, Feron, Singhose, Clarke, IEEE American Control Conference, 2011.

“Maximizing Throughput at an Intersection under Constrained Maneuvers,” Vela, Salaun, Feron, Singhose, Clarke, IEEE Conference on Decision and Control, 2010.

“Control of Holding Patterns for Increased Throughput and Recovery of Operations,” Vela, Feron, Singhose, Clarke, Digital Avionics Systems Conference, 2010.

“Topologically Based Decision Support Tools for Aircraft Routing,” Vela, Vela, Ogunmakin, Digital Avionics Systems Conference, 2010.

“Predicting Controller Communication Time for Capacity Estimation,” Vela, Salaun, Burgain, Singhose, Clarke, Feron, International Conference on Research in Air Transportation, 2010.

“A Conflict Resolution Algorithm For Reduced Controller Workload,” Augris, Vela, Salaun, Gariel, Feron, Clarke, AIAA Infotech, 2010.

“Airspace Statistical Proximity Maps Based on Data-Driven Flow Modeling,” Gariel, Salaun, Vela, Feron, Clarke, AIAA Infotech, 2010.

“Determining Bounds on Controller Workload Rates at an Intersection,” Vela, Salaun,

Gariel, Feron, Singhose, Clarke, American Control Conference, 2010.

“A Mixed Integer Program for Flight-Level Assignment and Speed Control for Conflict Resolution,” Vela, Solak, Singhose, Clarke, IEEE Conference on Decision and Control, 2009.

“Comparison of Residual Vibration and Energy-Minimizing Control Methods for Command Generation,” Singhose, Vela, Kim, IEEE Conference on Decision and Control, 2009.

“A Simplified Approach to Determine Airspace Complexity Maps under Automated Conflict Resolution,” Salaun, Vela, Feron, Clarke, Singhose, Digital Avionics Systems Conference, 2009.

“A Two-Stage Stochastic Optimization Model for Air Traffic Conflict Resolution under Wind Uncertainty,” Vela, Salaun, Singhose, Feron, Clarke, Digital Avionics Systems Conference, 2009.

“A Fuel Optimal and Reduced Controller Workload Optimization Model for Conflict Resolution,” Vela, Salaun, Solak, Feigh, Feron, Singhose, Clarke. Digital Avionics Systems Conference, 2009.

“Air Traffic Flow Management in the Presence of Uncertainty,” Clarke, Solak, Chang, Ren, Vela, Proceedings of the USA/Europe Seminar on Air Traffic Management Research & Development, 2009.

INVITED TALKS

“Benefits Analysis of a Runway Balancing Decision-Support Tool”, Vela. MIT Lincoln Laboratory: Air Traffic Control Workshop, FAA Headquarters, Washington, DC, Oct. 27, 2015.

“Understanding Conflict-Resolution Taskload: Implementing Advisory Conflict-Detection and Resolution Systems in an Airspace”, Vela. MIT Lincoln Laboratory, Lexington, MA, Sept. 19, 2011.

“Bounds of Performance in Air Transportation: Establishing and Optimizing Capacity in the Context of Safety,” Vela. Massachusetts Institute of Technology, Boston, MA, Jun. 21, 2010.

“Data Driven Approaches For Analytical Predictive Measures of Airspace Complexity,” Gariel, Vela, Salaun. Massachusetts Institute of Technology, Boston, MA, Mar. 31, 2010.

“Steps Towards Modeling Controller Taskload and Airspace Capacity using Mathematical Programming,” Vela. Korea Transport Institute, Seoul, Korea, Dec. 10, 2009.

PROFESSIONAL SERVICE

Session Chair, “Decision-Support Tools & Trajectory Optimization”, Digital Avionics Systems Conference, Seattle, WA, Oct. 2011.

Session Chair, “Traffic Conflict Management and Flow Management”, Digital Avionics Systems Conference, Salt Lake City, UT, Oct. 2010.

Invited Session Chair, “Air Traffic Control Systems Theory I”, IEEE Conference on Decision and Control, Atlanta, GA, Dec. 2010.

GRANTS

NSF International DDEP: Development of Aircraft Conflict Resolution Algorithms
Proposal #0832503.