Flightdeck Automation with 4D Trajectory Management and Control for the Next Generation ATM System

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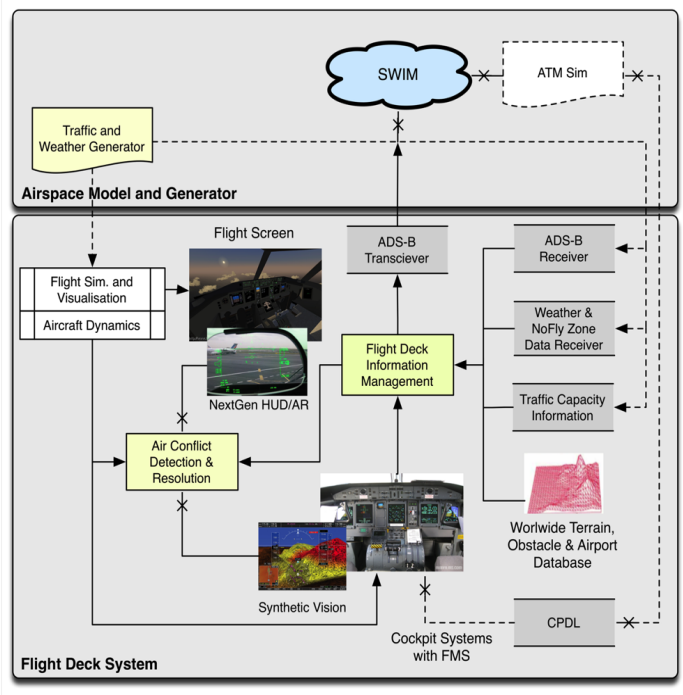
Aircraft trajectory management and control, and their current implementations are based on infrastructure and operations of ATM realm of the 20th Century. With NextGen (US), SESAR (EU) programs and their respective technology developments, the 2020 flight control implementations will rely on new Communication-Navigation-Surveillance (CNS) services, trajectory based operations and the System Wide Information Management (SWIM) capabilities to meet the growing demanding needs for safe and efficient operations in the face of ever increasing air traffic.



In this presentation, we first provide an overview of the new ATM realm and give insight on what the 4D trajectory management and control could provide towards safer and more efficient (i.e. in terms of cost and delays) operations. Next we show a futuristic automation system which offers persistent in-flight hazard and flight efficiency monitoring and tactical flight trajectory planning as a function of look-ahead time and dynamically changing environmental/operational conditions.

The developed automation support system is tested on a Boeing 737-800NG FNPT II level Flight Simulator with conceptual procedures enabling intent data exchange, automated flight control implementations, and synthetic vision based decision support system.
The developed automation system offers persistent in-flight hazard and flight efficiency monitoring and tactical flight trajectory planning as a function of look-ahead time and dynamically changing environmental/operational conditions.

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Gokhan Inalhan is a Professor at Istanbul Technical University and serves as the Director of ITU Aerospace Research Center. He received his Ph.D. degree in Aeronautics and Astronautics from Stanford University with Ph.D. minor in Engineering Economic Systems and Operations Research in 2004. Between 2004 and 2006 he had worked as a Postdoctoral Associate at Massachusetts Institute of Technology. During this period, he had led the Communication and Navigation group in the NASA CER project. He is a member of IEEE and IFAC Technical Committee on Aerospace Control and NATO Research Technology Organization (RTO), Systems Concepts and Integration (SCI) Group. His current research includes nonlinear flight control systems for manned and unmanned aircraft, flight simulators, decision-support systems and flight deck automation, new generation avionics systems, navigation and guidance algorithms for complex environments, and hybrid systems.

Emre Koyuncu is an Assistant Professor at Istanbul Technical University in the Department of Aeronautical Engineering. He has received his B.Sc. degree in Electrical Engineering from ITU in 2005, M.Sc. degree in Mechatronics Engineering from ITU in 2008, and Ph.D. degree in Aerospace Engineering from ITU in 2015. He was a visiting researcher at Boeing Research and Technology of Europe during 2013-2014, and Massachusetts Institute of Technology (MIT), Aero-Astro Department during 2014-2015. In his Ph.D. research, he has received SESAR WP-E HALA! Research Network Ph.D. fellowship. Prof. Koyuncu has developed optimized trajectory design methods, which rely on large-scale data analysis and stochastic search methods. These methods have been applied to both short and also medium tactical term optimal 4D trajectory management and conflict resolution for commercial aircraft and UAVs. He also designed an in-cockpit decision support systems utilizing these algorithms. His current research focuses on; developing computationally efficient planning algorithms; airborne conflict avoidance and resolution algorithms; high-level autonomy in air traffic control systems; flight-deck decision support, conflict avoidance and upset recovery systems; survivability analysis for complex air combat missions and mission planning; data-driven ATM network modeling; resilience problem in large scale complex systems with multiple decision makers.

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