

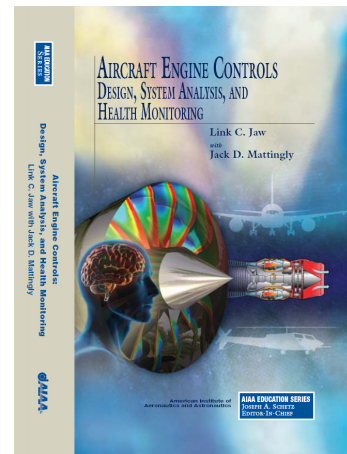
Aircraft Engine Controls

Design, System Analysis, and Health Monitoring

Link C. Jaw
with Jack D. Mattingly

(An AIAA Education Series book)

Because of its efficiency and reliability, the gas turbine engine is the predominant choice for aviation propulsion. For most aviation applications, however, a gas turbine engine must provide predictable thrust performance over the entire operating envelope of the engine, covering altitudes ranging from below sea level to tens of thousands of feet above. These altitude changes, along with differing flight speeds from takeoff to supersonic velocities, result in large variations in engine inlet temperature, inlet pressure, and exhaust pressure.



These large variations in engine operating conditions, coupled with the need for precise thrust control and highly reliable operation, create a significant challenge for the design of engine control systems, especially given the complexity of the engine itself. Controlling such complex machinery requires a thorough understanding of the performance of the engine system as a whole.

This book covers the design of engine control and monitoring systems for both turbofan and turboshaft engines, focusing on four key topics: 1) modeling of engine dynamics; 2) application of specific control design methods to gas turbine engines; 3) advanced control concepts; and 4) engine condition monitoring.

Although principally concerned with aircraft engines, this book is applicable to all air, land, and sea-based gas turbines, since most of the issues in designing other gas turbine control systems will be subsumed within the substantial challenges inherent in designing aviation gas turbine control systems. Indeed, since gas turbine engine control and monitoring systems have successfully incorporated *nonlinear control* and *system health*

management, this book is not only a comprehensive resource for understanding the problems facing modern engine control and monitoring system designs, it can also be used as a reference for engineers and researchers designing control and monitoring systems for other industrial equipment and systems, because the modeling techniques, design methodologies, and problem-solving approaches are similar in all industries.

The book is based on a course on gas turbine engine controls developed and taught by Dr. Jaw and Dr. Mattingly during 2005–2007 to Air Force, Navy, and Army engineers. In addition to six chapters on engine control analysis and design, chapters are included on integration with aircraft systems, advanced engine control concepts, and engine monitoring and health management.

About the authors



Dr. Jaw is the President of Scientific Monitoring, Inc. (SMI) in Scottsdale, Arizona. He has more than 20 years of industry experience in controls, monitoring, and software, and has been awarded 10 U. S. patents. Prior to SMI, he worked for Garrett Turbine Engine Company (now a division of Honeywell Aerospace), Link Flight Simulation (now a division of L3 Communications), FlightSafety Simulation, and Aero Industry Development Center in Taiwan. He received his B.S. in Aeronautical Engineering from Tam Kang College in Taipei, Taiwan, his M.S. in Aerospace Engineering from the University of Michigan, and his Ph.D. in Aeronautics and Astronautics from Stanford University.



Dr. Mattingly received his B.S. and M.S. in Mechanical Engineering from the University of Notre Dame, and his Ph.D. in Aeronautics and Astronautics from the University of Washington. During his 40 years of experience in analysis and design of propulsion and thermodynamic systems, he has written two engineering textbooks, developed aerothermodynamic cycle analysis models, and created engineering software for air-breathing propulsion systems. Dr. Mattingly has more than 35 years of experience in Engineering Education, teaching at the United States Air Force Academy, the Air Force Institute of Technology, the University of Washington, the University of Notre Dame, the University of Wisconsin, Seattle University, and IBM Corp.