

Aerospace Engineering Thesis Defense

The Supersonic Performance of High Bypass Ratio Turbofan Engines with Fixed Conical Spike Inlets

School for Engineering of Matter, Transport and Energy

Spencer Cleary

Advisor: Timothy Takahashi

abstract

The objective of this study is to understand how to integrate conical spike external compression inlets with high bypass turbofan engines for application on future supersonic airliners. Many performance problems arise when inlets are matched with engines as inlets come with a plethora of limitations and losses that greatly affect an engine's ability to operate. These limitations and losses include drag due to inlet spillage, bleed ducts, and bypass doors, as well as maximum and minimum values of mass flow ratio at each Mach number that define when an engine can no longer function. A collection of tools was developed that allow one to calculate the raw propulsion data of an engine, match the propulsion data with an inlet, calculate the aerodynamic data of an aircraft, and combine the propulsion and aerodynamic data to calculate the installed performance of the entire propulsion system. Several trade studies were performed that tested how changing specific design parameters of the engine affected propulsion performance. These engine trade studies proved that high bypass turbofan engines could be developed with external compression inlets and retain effective supersonic performance. Several engines of efficient fuel consumption and differing bypass ratios were developed through the engine trade studies and used with the aerodynamic data of the Concorde to test the aircraft performance of a supersonic airliner using these engines. It was found that none of the engines that were tested came close to matching the supersonic performance that the Concorde could achieve with its own turbojet engines. It is possible to speculate from the results several different reasons why these turbofan engines were unable to function effectively with the Concorde. These speculations show that more tests and trade studies need to be performed in order to determine if high bypass turbofan engines can be developed for effective usage with supersonic airliners in any possible way.

April 5, 2018; 4:30 PM; ECG 335