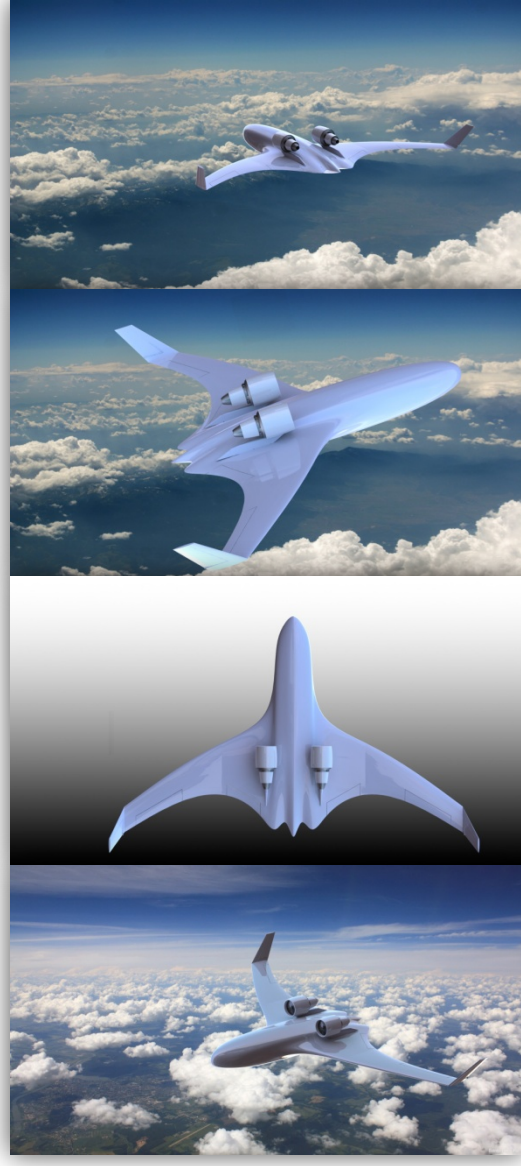
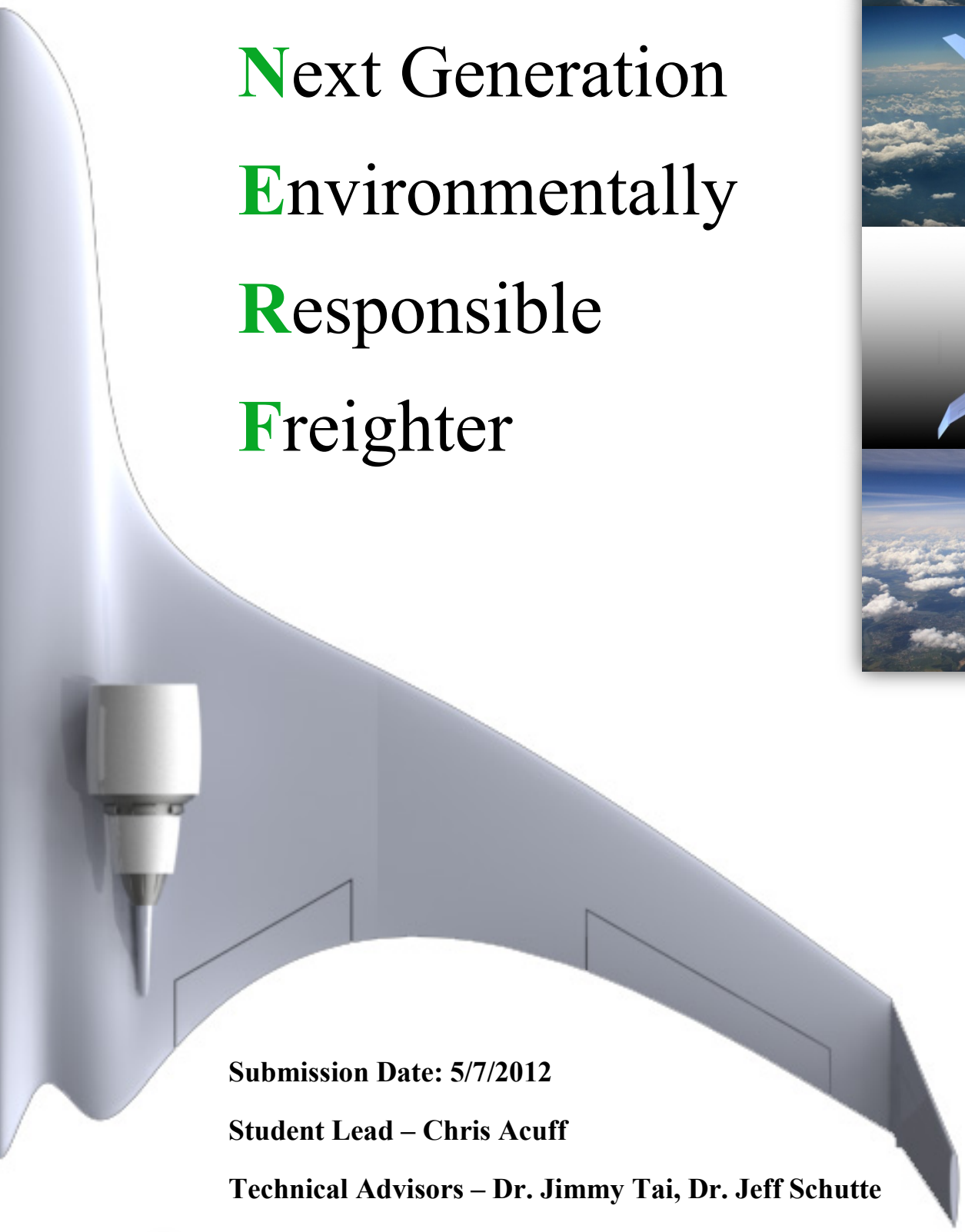
Environmentally Responsible Aviation
University Engineering Design Contest



Next Generation Environmentally Responsible Freighter



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Abstract

The conceptual design phase for a dedicated freighter aircraft was conducted for the NASA Environmentally Responsible Aviation University Engineering Design Contest. The aircraft was designed to meet NASA's N+2 goals which include a 42 dB reduction in cumulative noise below Stage 4, a 75% reduction in LTO NOx emissions, a 70% reduction in cruise NOx emissions, and a 50% reduction in aircraft fuel consumption. The university design competition mission required a 6,500 nautical mile range with a 100,000 lb. payload, a nominal cruise mach of 0.85, and an optionally manned capability.

To analyze the problem and enable the design process, two tools were developed. The RADiCAL (Rapid Drag Calculator) tool uses surrogate models and calibration factors to calculate drag polars for blended wing body aircraft across varying cruise conditions. The MINT (Multidisciplinary Integration Tool) enables analysis with EDS (Environmental Design Space) by translating RADiCAL output into EDS input files.

Using RADiCAL, MINT, and EDS, NERF (the Next-Generation Environmentally Responsible Freighter) was designed. NERF is a blended wing body concept utilizing a unique, triple payload compartment fuselage, ultra-high bypass geared turbofan engines, airframe engine noise shielding, and an advanced N+2 technology package. With these features NERF successfully exceeds three out of four of NASA's N+2 goals. Fuel burn is reduced by 54%, LTO NOx is reduced by 78%, and cumulative noise is reduced 61 dB. The Cruise NOx goal is not met with NERF only achieving a 54% reduction whereas a 70% is required to meet the goal.

A brief assessment of the feasibility of NERF is conducted in closing. NERF is deemed currently infeasible, but with focused technology research could likely be made feasible by 2020. In this way assistance coming in the form of government or military support of NERF or a similar concept would greatly improve feasibility in the short term. The feasibility of NERF's optionally manned capability is deemed largely dependent on general advances in UAS in the NAS.