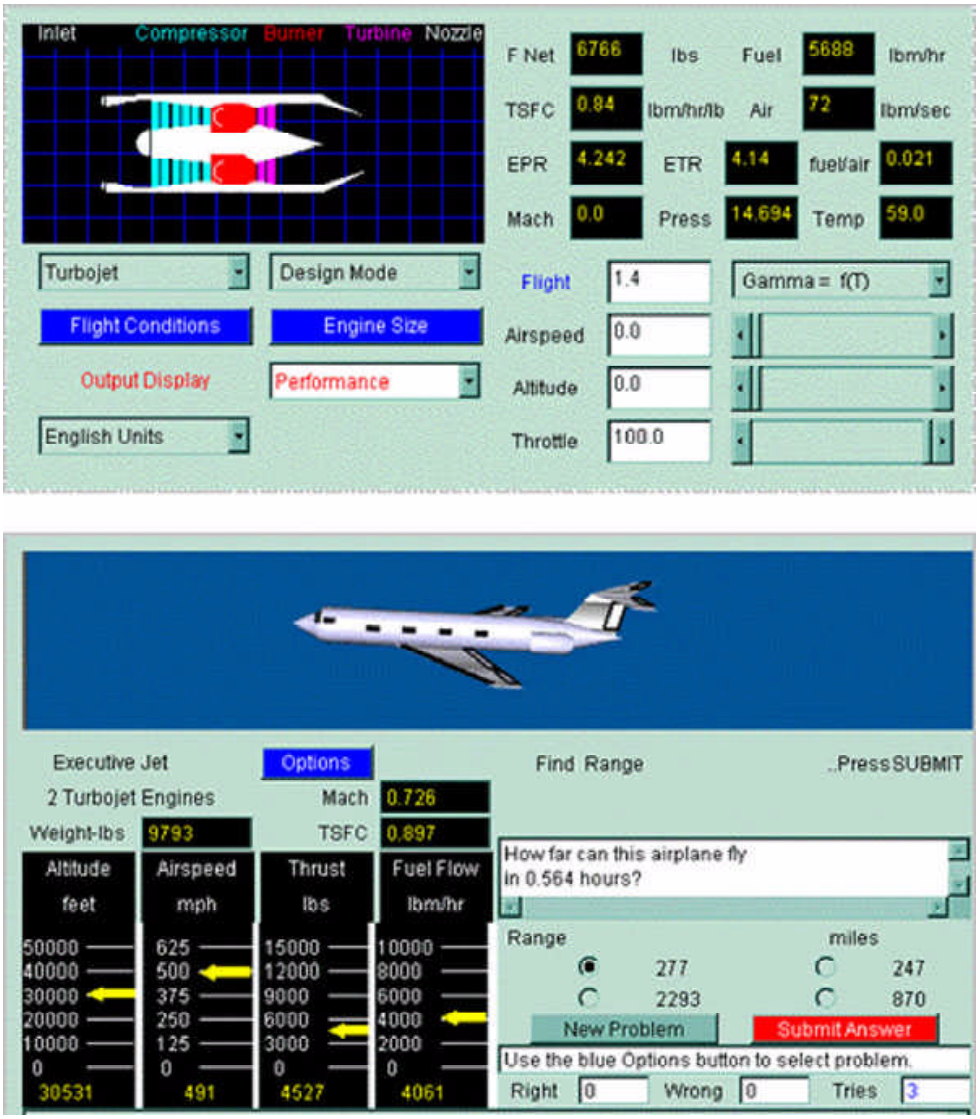
EngineSim: Turbojet Engine Simulator Adapted for High School Classroom Use

EngineSim is an interactive educational computer program that allows users to explore the effect of engine operation on total aircraft performance. The software is supported by a basic propulsion web site called the *Beginner's Guide to Propulsion*, which includes educator-created, web-based activities for the classroom use of EngineSim. In addition, educators can schedule videoconferencing workshops in which EngineSim's creator demonstrates the software and discusses its use in the educational setting. This software is a product of NASA Glenn Research Center's Learning Technologies Project, an educational outreach initiative within the High Performance Computing and Communications Program.

EngineSim consists of two parts: (1) a range program that includes rate and force problems of different levels of difficulty and (2) a design program that models the design and testing of jet engines.



Top: EngineSimDesign. Bottom: EngineSimRange.

EngineSimDesign calculates the one-dimensional thermodynamic performance of a simple turbojet engine, a turbojet with an afterburner, a two-spool turbofan engine, or a ramjet engine. It can be used to design an engine or to evaluate the engine's off-design performance. In the design mode, students can change design variables such as the flight conditions, the engine size, the inlet performance, the turbomachinery compressor and turbine performance, the combustors or burner performance, and the nozzle performance. The student's design can then be tested in Tunnel Test Mode, where the student can vary the flight conditions (airspeed, altitude, and throttle setting).

EngineSimRange uses jet engines to present a variety of rate and force problems of different levels of difficulty. The rate problems deal with how far and how long an airplane can fly on a given amount of fuel, and the force problems deal with Newton's laws of motion on takeoff. Students can choose a play mode, a learn mode (in which the student's chances to determine the correct answer are limited), or an exam mode (in which the

student gets one chance to determine the correct answer and the answer is recorded for the teacher). Graphical feedback is given for each answer choice.

EngineSim was created to illustrate an example of the research being conducted at Glenn and is designed to be an intuitive tool to supplement and enhance math and science curricula. It was originally written for college-level engineering students (VU-TURBO). Adjustment of the code to the high school level resulted in EngineSim, which was created and tested by a diverse team composed of NASA employees, contractors, and educators. Glenn's Learning Technologies Project participates in NASA's Learning Technologies Project, which is managed by the NASA Ames Research Center.

Glenn Learning Technologies Project (http://www.grc.nasa.gov/WWW/K-12/)
EngineSimRange (http://www.grc.nasa.gov/WWW/K-12/airplane/ngnsimr.html)
EngineSimDesign (http://www.grc.nasa.gov/WWW/K-12/airplane/ngnsim.html)
Beginner's Guide to Propulsion (http://www.grc.nasa.gov/WWW/K-12/airplane/bgp.html)
Beginner's Guide to Propulsion Problem Sets (http://www.grc.nasa.gov/WWW/K-12/BGP/BGPindex.html)

Glenn contact: Tom J. Benson, 216-433-5920, Thomas.J.Benson@grc.nasa.gov
Author: Ruth A. Petersen
Headquarters program office: OAT
Programs/Projects: HPCCP, LTP