Alex Burd
Sandia Prep
Team 109

Summary:
Basically, I have investigated the plausibility of a dual mode scramjet capable of sustained speed at subsonic, supersonic, and hypersonic speeds. This is very important, as current scramjets can only operate once high speeds have already been reached, which is inefficient. My idea was to place a conventional turbofan engine inside the scramjet, give it a titanium sheathing for heat and pressure protection, and curve it outward to increase the effects of Bernoulli's principal. I was fairly sure this would work; similar, but still fairly different technology fueled the power plant of the famous SR-71 Blackbird, capable of sustained speed at over mach 3. The only original problem was finding a computational fluid dynamics software program that met my needs. This is because CFD comes in different forms, depending on the application. I was particularly looking for a Navier-Stokes equation program hopefully with a Baldwin Lomax limiter. After several weekends of researching plausible software, I believed I had found my solution. A Glenn research center program called SWIFT v. 400. Although I placed numerous calls to the software team at Glenn research center, none were returned, and I was unable to use the software package effectively. My entire project on the line, I frantically began searching for usable software. After reading a handful of academic papers, I once again believed I had the answer to my solution, however, like all other software, it wasn't working out, and the company refused to answer my attempts at contact for more information.
Eventually I stumbled upon something interesting, a method of photography called Schlieren photography. It is able to photograph air currents and changes in air density, and was used before computers had even been built to show the shockwave patterns of bullets. Here is an example:

Courtesy of http://rainbowboys.blogspot.com/2010/11/schlieren-photography.html
As of today I am still unable to get the photography to work. I am continuing to fine tune it and I hope that I will have something to present at the expo.

Overview:
Hypersonic aircraft are just now emerging from NASA, and once developed stronger they will be used in numerous applications. Uses range from rapid military logistics, such as the DARPA falcon HTV-2, which will be able to deliver a payload (most likely weaponized) anywhere in the world in under an hour, to

high speed passenger flights, which could go from New York to Tokyo in two and a half hours. The main problem is that hypersonic aircraft as we know them require two different engines to function; a conventional turbofan to get to the proper speed and altitude, and a scramjet to then begin hypersonic flight. However, carrying two different engines is not practical. The military has developed and is developing hybrid turbojet/ramjets, but ramjets are not as efficient as scramjets for hypersonic flight. Therefore, I am going to attempt to model a hybrid turbojet/scramjet.

Although I was not able to get as much analysis of my idea as I had hoped, I still feel that the project went well overall. I was able to learn quite a bit by researching on the subject, even though no one has ever even attempted to work on this type of engine. I am hoping that if I can find some useful software and get feedback from the developers, I will have enough information for a patent; as I am confident that this research is groundbreaking enough. At this time, I would like to thank my parents for helping, Mr. McBeth for being a fantastic mentor, the man behind ian.org for giving so much information on Schlieren photography, the judges that listened tomy presentation and gave me some excellent feedback, and Mr. Suding of my school physics department for allowing me to use his large and expensive concave mirror.