

Friendlier Skies

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Introduction

Our team from Lockheed Martin Aeronautics won an engineering award in 2011 for a project that involved optimizing the flight patterns of fighter jets to minimize the noise that affects surrounding neighborhoods. JMP® statistical discovery software from SAS helped us evaluate flight patterns in the vicinity of a base, and the project won the Distinguished Engineering Project Achievement Award from the San Fernando Valley Engineers' Council. The complete process, Rapid Profile Development Methodology (RPDM), produces accurate results quickly, and stimulates creative solutions. The development of this methodology allowed us to rapidly change airplane parameters and flight conditions and then look at the resulting impact on the noise for the community. This process is much quicker and easier using JMP®. We can accomplish in seconds what used to take hours or days to perform.

Methods

Transforming data into understanding

Aircraft noise is not only an annoyance; it can affect housing values as well. Addressing the issue helps the military maintain good relations with its neighbors. To balance community concerns about noise in conjunction with pilots' concerns about flight safety, our team developed a process to establish community-friendly and pilot-friendly procedures that reveal the optimal "takeoff profile" for various types of fighter aircraft at specific airbases.

Rapid Profile Development Methodology

The backbone of RPDM is the JMP® Regression Equations. Data is generated from a detailed Mission Analysis Code for a specific aircraft and engine. In order to quickly compute airplane climb, cruise, and descent performance, the airplane's energy and power characteristics are fitted to a response surface equations using JMP's stepwise regression process. Figure 1 illustrates the graphics for the Stepwise Regression process and evaluation of the actual and predicted data with JMP's Fit Model. Thereafter, airplane performance can be computed through evaluating a simple (large) equation. One of the equation is shown in JMP's Prediction Profiler in Figure 2. The equations are used to determine flight profiles and linked to computer programs from the US Air Force and the Federal Aviation Administration to calculate noise levels.

This analysis is used to determine the noise-reduction potential of proposed changes to flight procedures. By changing the weight, power setting, altitude, and flight profile of the aircraft during takeoff and landing, the impact on the community noise can be evaluated. In Figure 3, a 52% reduction in the 55 DNL noise contour was achieved by using RPDM. Having the regression equations from JMP® means that new flight profiles can be developed without having to delve back into the detailed analysis code. Not only does this process reduce manual input errors, but we can accomplish in seconds what used to take hours or days to perform previously.

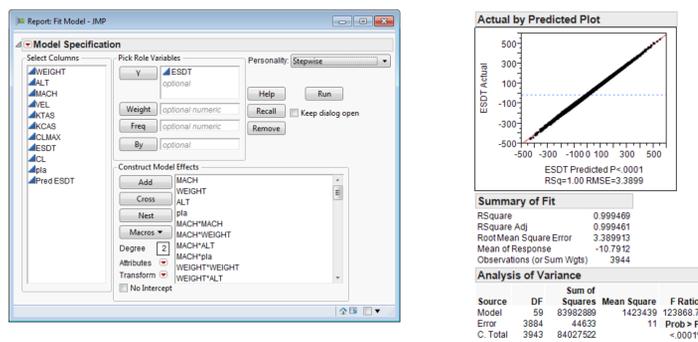


Figure 1. Design Simulation Data is Fit and Analyzed in the Fit Model Platform.

Results

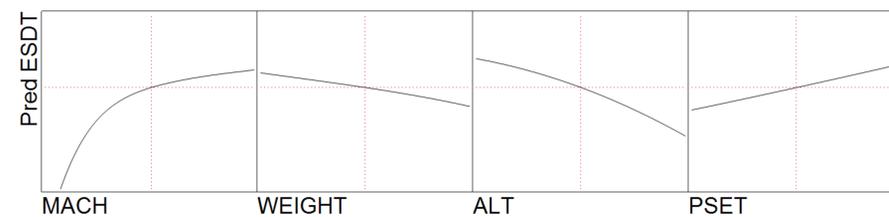


Figure 2. Profiler of JMP® Regression Equation used in RPDM

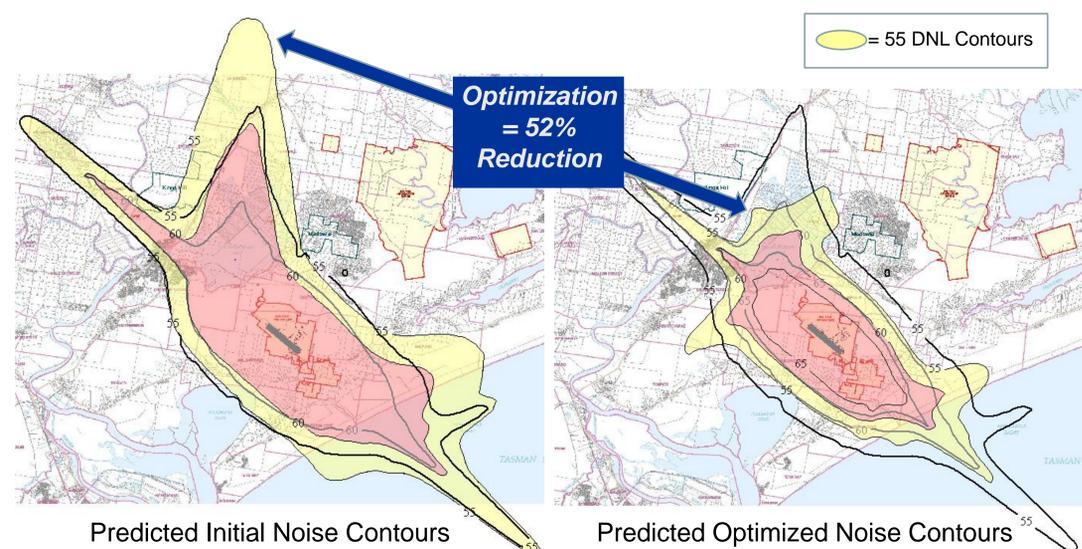


Figure 3. Reduction in Predicted Noise Contours generated with Noisemap through the use of RPDM

Discussion

- Using JMP® Equations, you don't have to be an expert in the original detailed code to evaluate the results of changing inputs to the code.
- RPDM allows the rapid construction of a new profile without having to go back to the detailed code
- Adjustments to power settings, climb angles, weight, altitude, afterburner settings, and other parameters can significantly reduce the noise levels.
- Our team can look at the impact of the change in the aircraft profile on the noise contours and suggest ways to tailor flight profiles for a given community
- The tailoring of the profiles can affect the number and type of aircraft purchased by a community and country.

Reference

Wasmer Consulting is the author of Noisemap and NMPlot
<http://wasmerconsulting.com/index.html>

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