Solving Data Analysis Challenges Using MATLAB and Statistics Products

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MathWorks Symposium

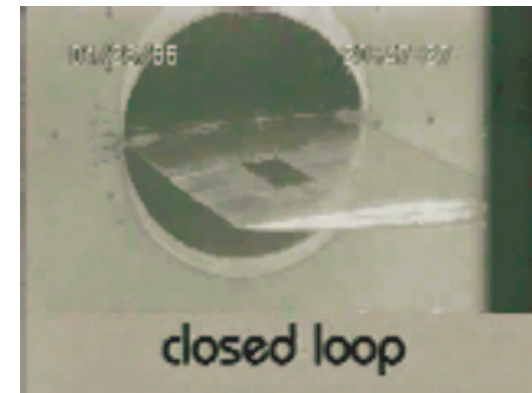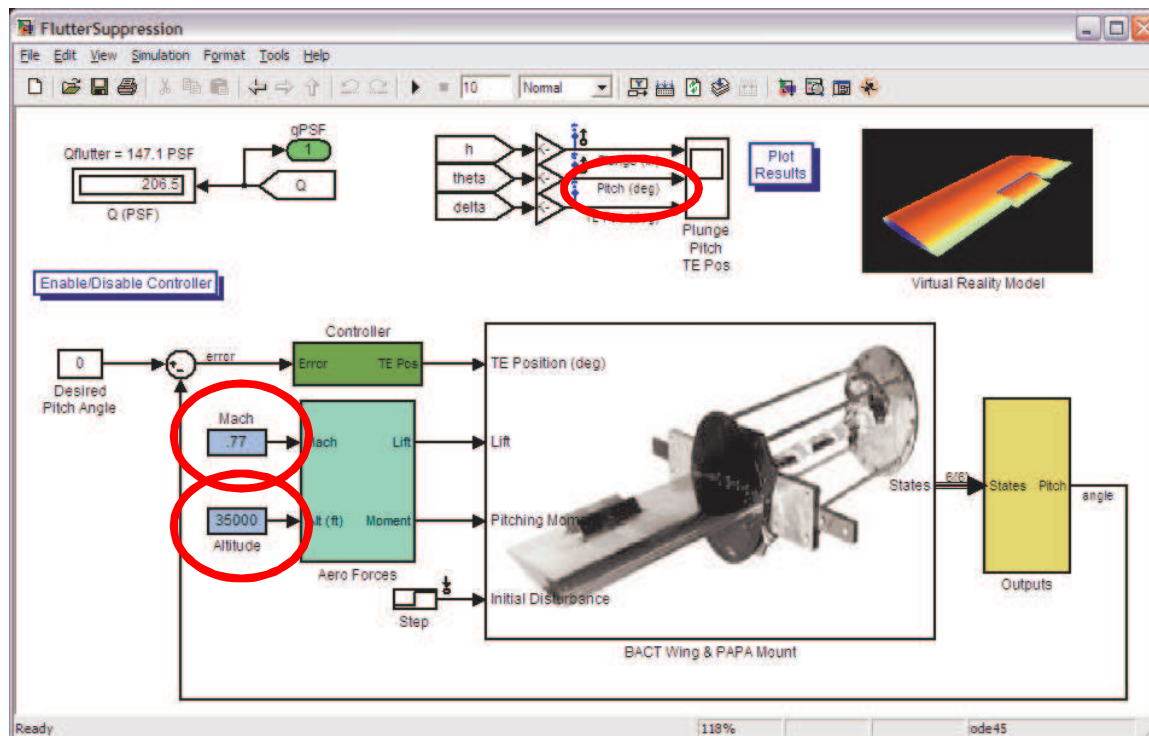Adopting Model-Based Design within Aerospace and Defense

Demo:
Flutter Suppression Controller Analysis

Goal: How to use MATLAB for

- Data manipulation
- Feature extraction
- Visualization
- Modeling
- Batch processing

Demo:
Flutter Suppression Controller Analysis

Challenge: Find stability boundary of flutter suppression controller

Simulink model

BACT wind-tunnel mod

Demo:
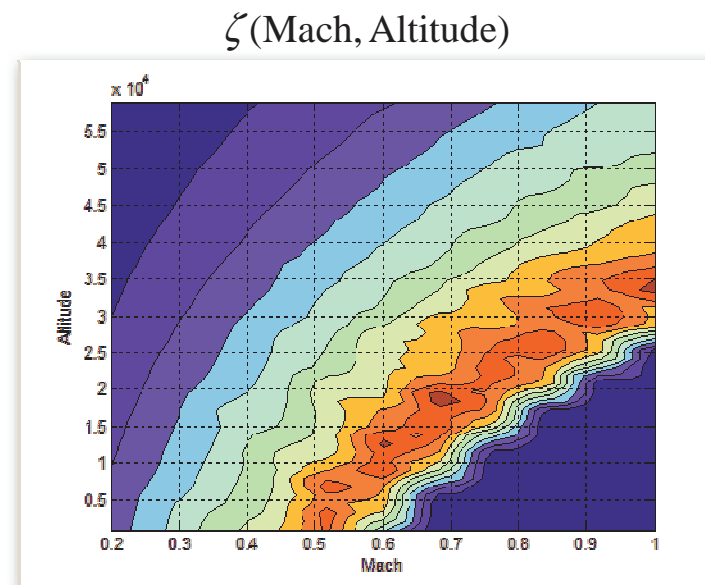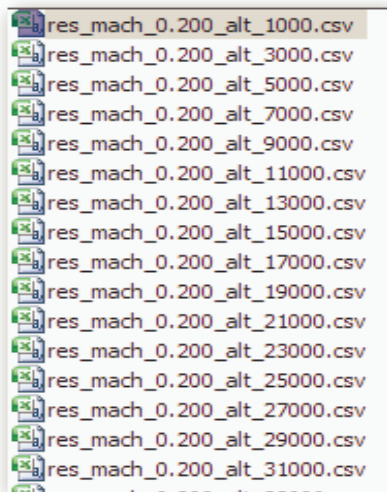## *Flutter Suppression Controller Analysis*

Challenge:

Find stability boundary of flutter suppression controller

- Model **damping ratio** of sensor position in function of **mach** and **altitude**
- Test data in 330 spreadsheets (for varying **mach and altitude**)
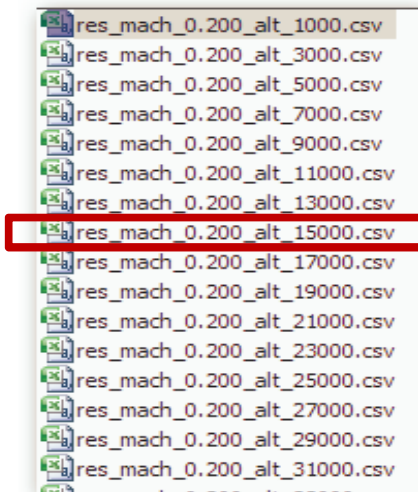- For each dataset need to compute **damping ratio**
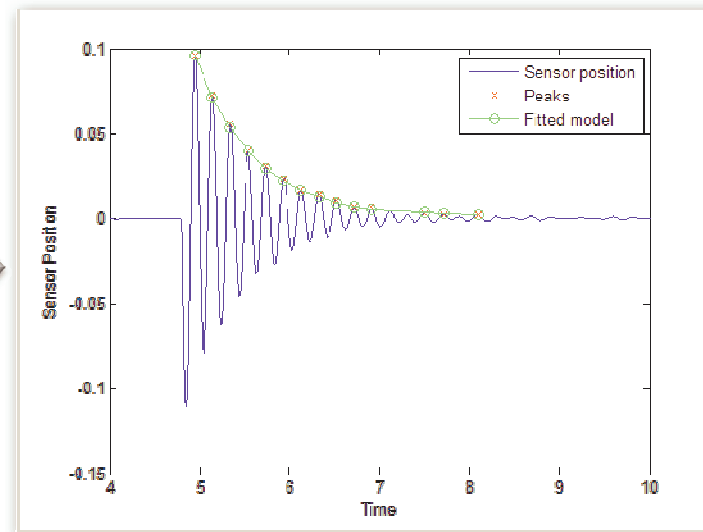

ζ(Mach, Altitude)

Demo:
Flutter Suppression Controller Analysis

Approach:

- Compute damping ratio for signal in a single file
- Save the processing routines as a script

Interactive analysis

Demo:
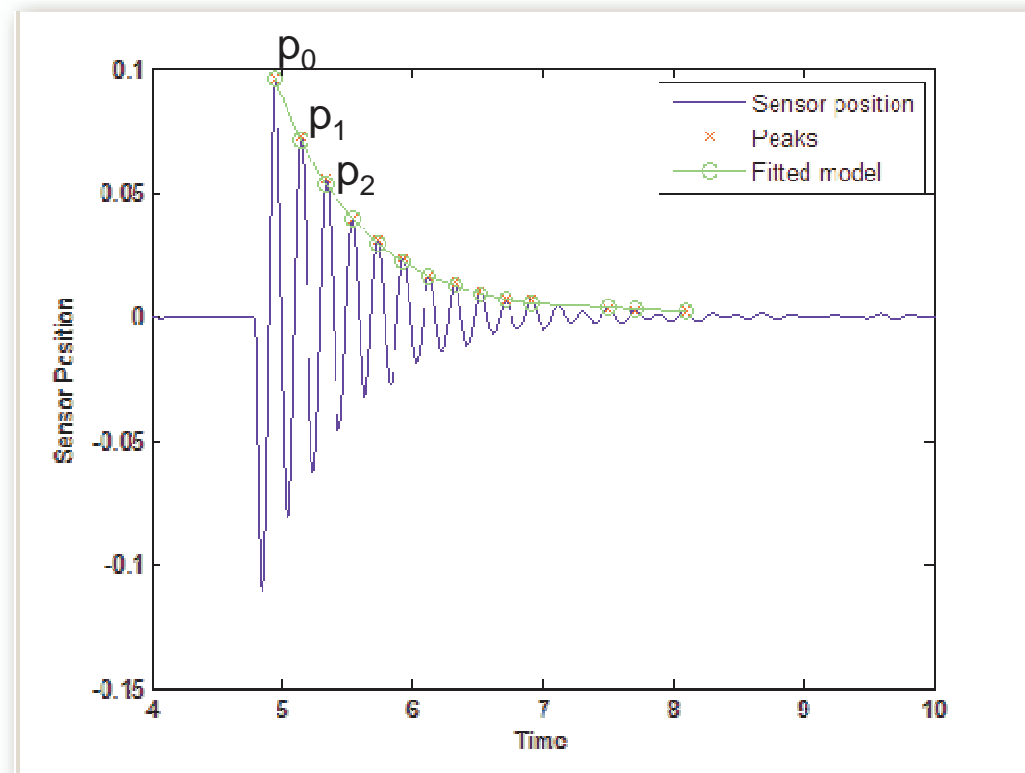## *Flutter Suppression Controller Analysis*

Computing damping ratio

- Extract interval of interest
- Compute peaks
- Compute logarithmic decrement via curve fitting

$$e^{\delta n} = \frac{p_0}{p_n}$$

- Compute damping ratio as

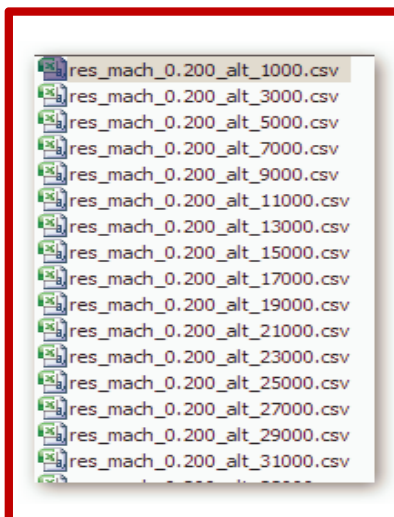$$\zeta = \frac{\delta}{\sqrt{(2\pi)^2 + \delta^2}}$$
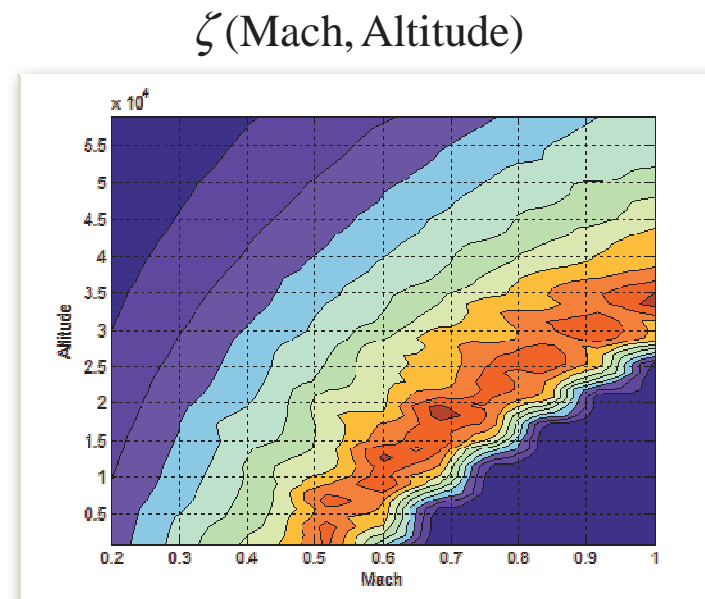
Demo:
Flutter Suppression Controller Analysis

Approach:

- Compute damping ratio for signal in a single file
- Save the processing routines as a script
- Compute ratio for each file using batch processing
- Model the result

$\zeta\,(\text{Mach, Altitude})$

Batch processing

Demo:
Flutter Suppression Controller Analysis

Summary: How to use MATLAB for

- Data manipulation
- Feature extraction
- Visualization
- Modeling
- Batch processing

Questions?

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Statistics Toolbox

Statistics Toolbox provides interactive and command line tools for:

- Data collection and management

- Descriptive statistics

- Multivariate statistics

- Probability distribution fitting and modeling

- Hypothesis testing

- Analysis of variance/covariance

- Linear and nonlinear modeling

- Visualization

- Statistical Process Control
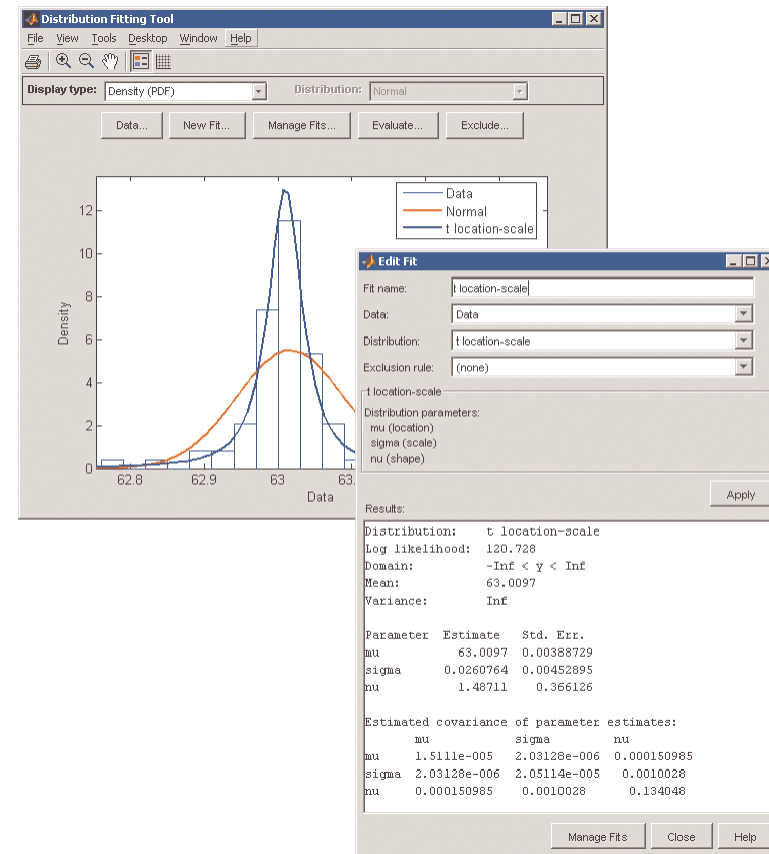
Curve Fitting Toolbox

Graphical user interface and command line functions for:

- Previewing and preprocessing data

- Developing, comparing, and managing models

- Extensive library of linear, nonlinear, and nonparametric models

- Customizable model fitting

- Interpolation, extrapolation, differentiation, and integration