

Introduction to Statistical Energy Analysis

Richard G. DeJong
Calvin College

SEA Introduction

1. What is SEA?
2. Why SEA?
3. Basics of SEA.

What is SEA?

Statistical Energy Analysis

A method of analyzing the flow of dynamic energy in systems based on the statistical coupling of the dynamic modes of response of the system.

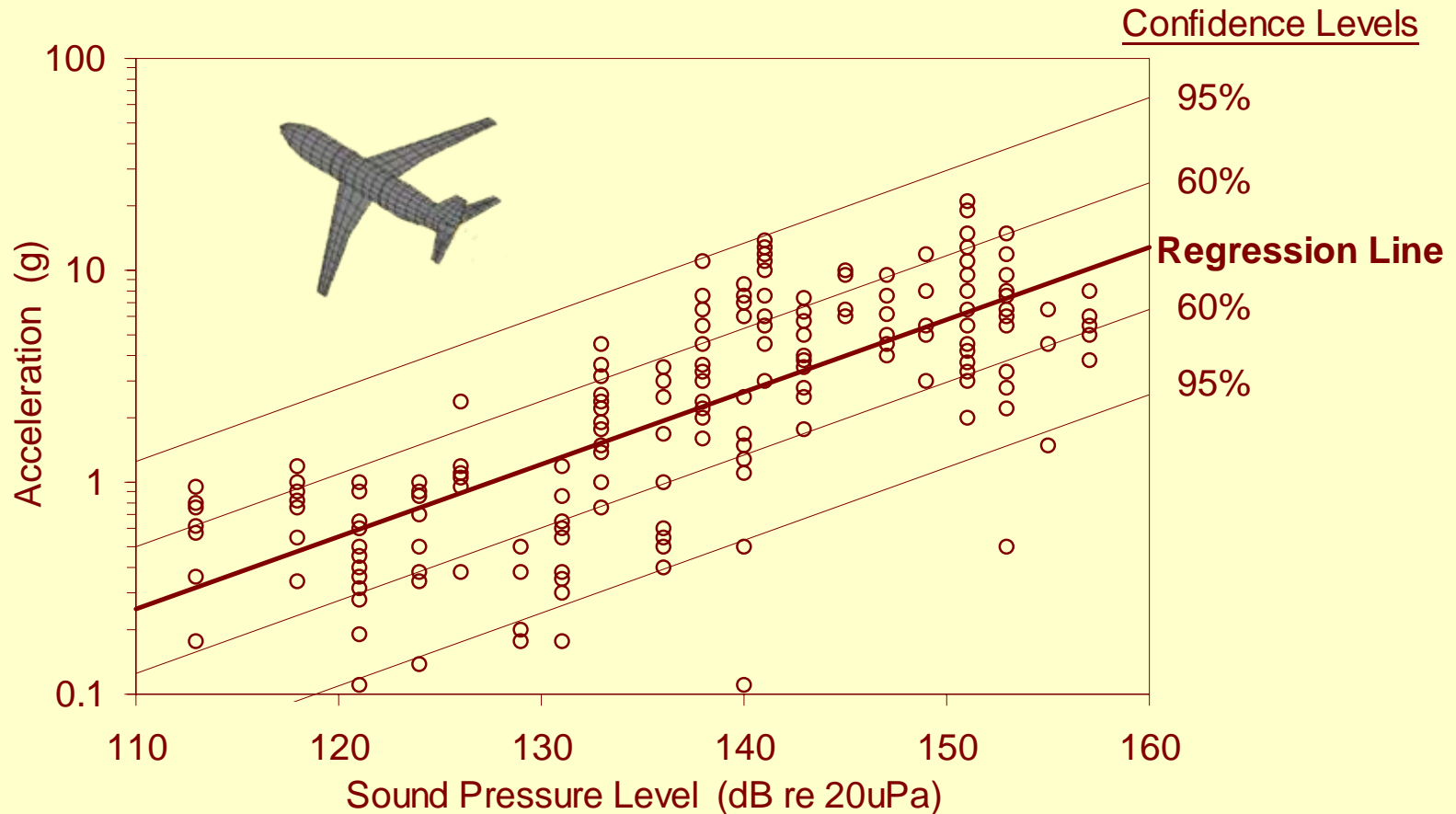
What is SEA?

- Statistical - Determines the statistics of the dynamic response of systems. (mean value and variance)
- Energy - Uses the dynamic energy flow as the primary response variable. (vibration and sound levels are derived)
- Analysis - Initially a conceptual framework for analysis. Now a fully computerized prediction tool.

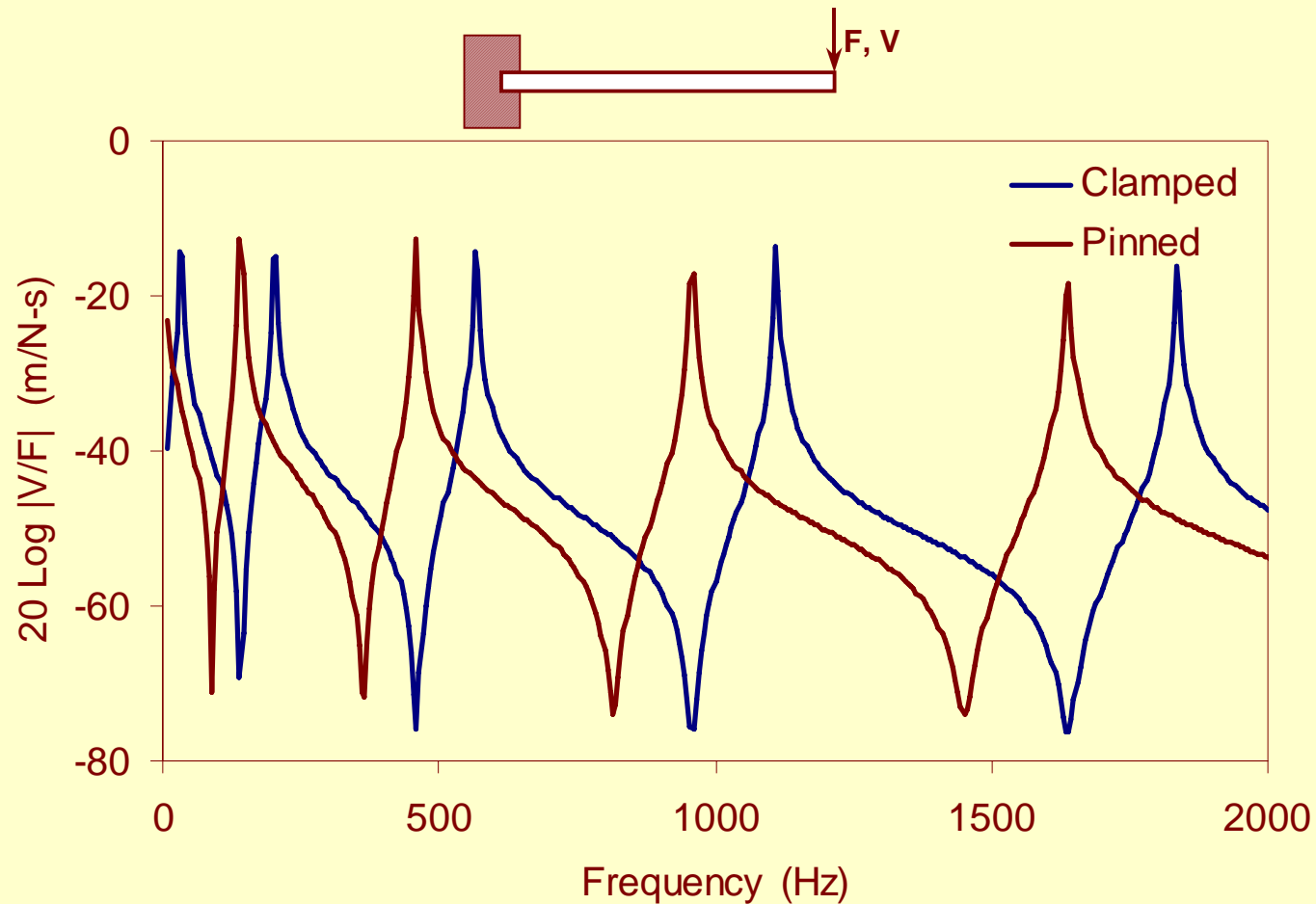
Why Statistics?

1. The modes in an ensemble of nominally identical systems are distributed statistically.
2. The modes in a complicated system appear to be distributed statistically.

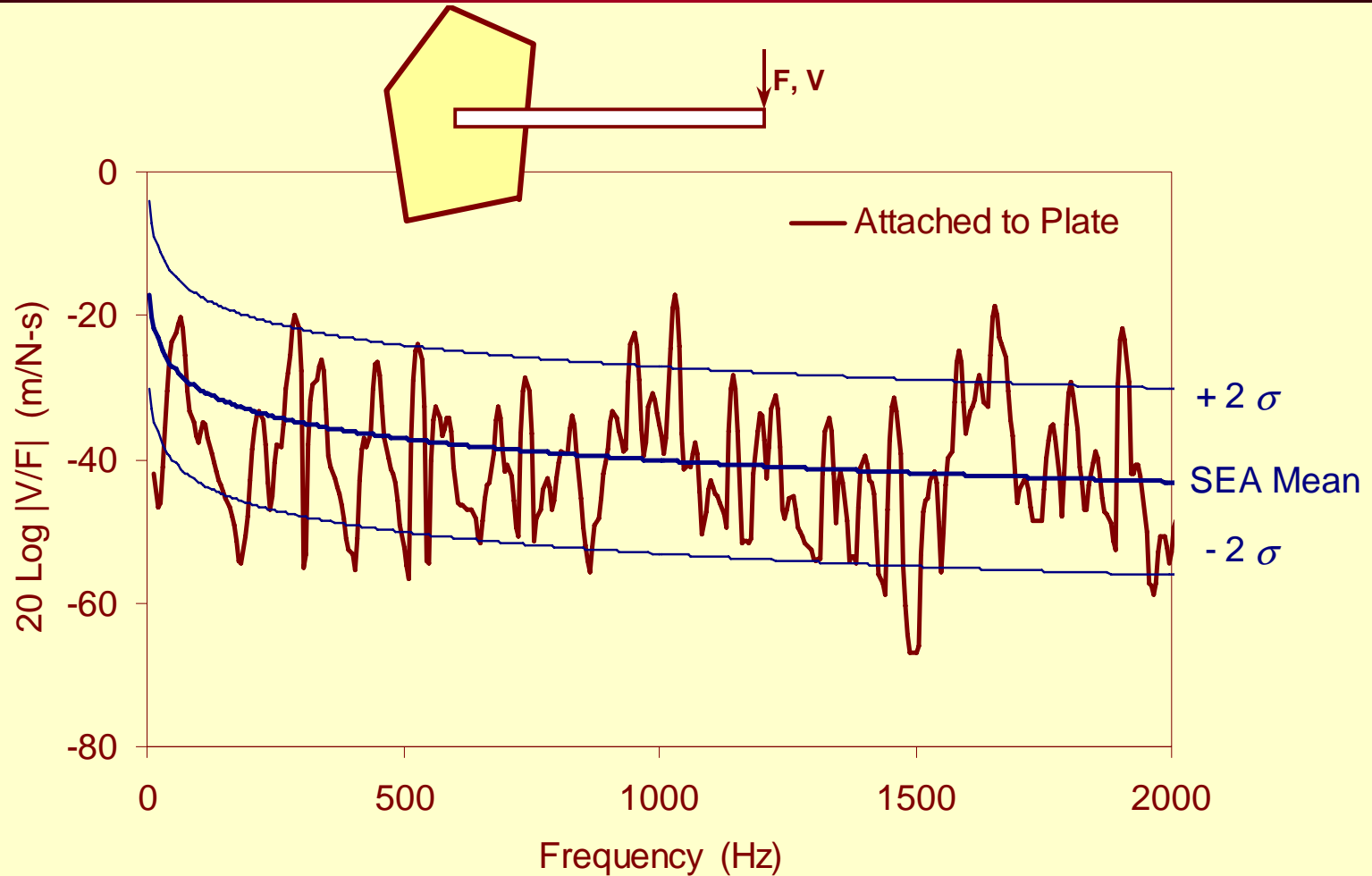
Correlation of Acceleration and Pressure Levels on B-58 Airplane at 1000 Hz (1967)



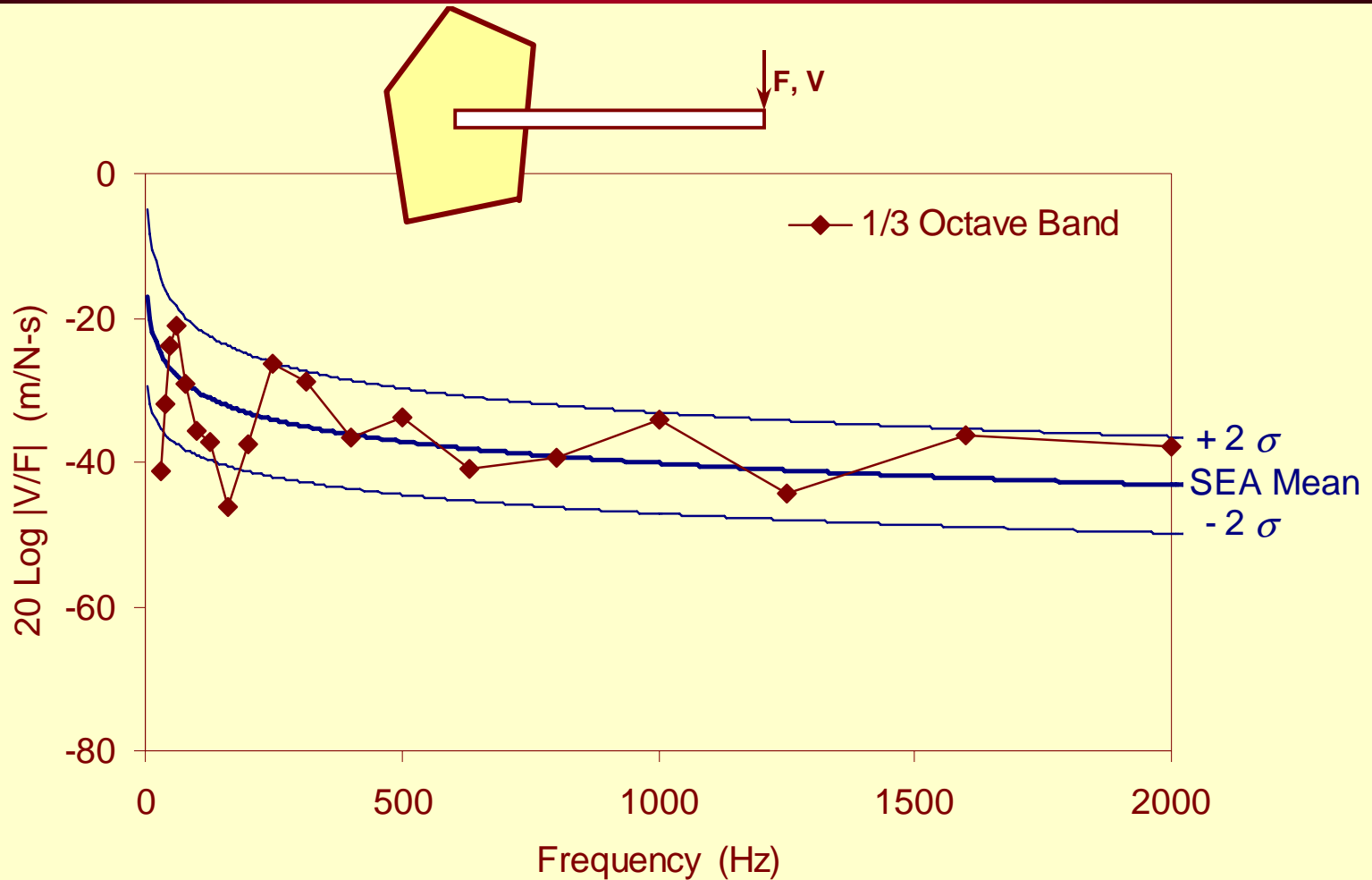
Vibration Response of a Beam



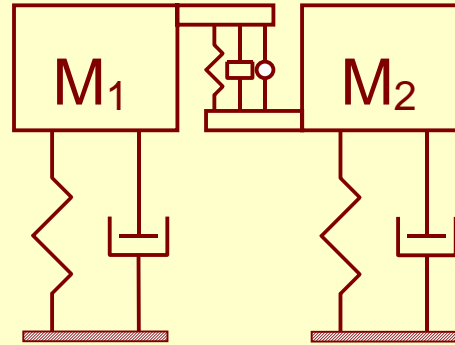
Vibration Response of a Beam



Vibration Response of a Beam



SEA Basics

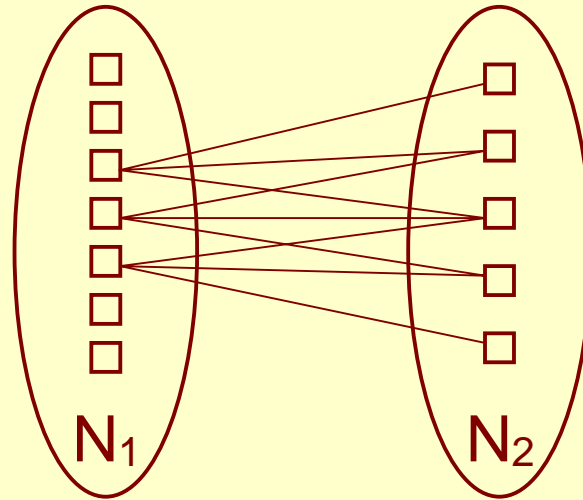


Lyon (1962)

$$\text{Energy: } E_i = M_i \langle V_i^2 \rangle$$

$$\text{Power: } P_{12} = B_{12} (E_1 - E_2)$$

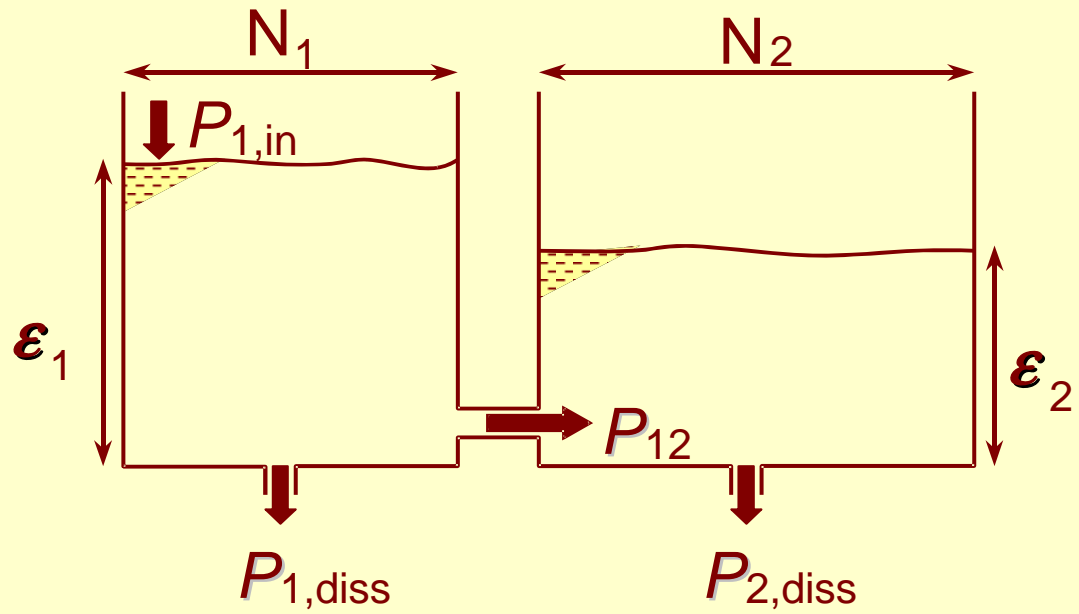
SEA Basics



$$P_{12} = N_1 N_2 \langle B_{12} \rangle (E_1/N_1 - E_2/N_2)$$

$$P_{12} = \beta_{12} (\epsilon_1 - \epsilon_2)$$

SEA Basics



$$P_{1,in} = \beta_{12} (\epsilon_1 - \epsilon_2) + P_{1,diss}$$

$$\beta_{12} (\epsilon_1 - \epsilon_2) = P_{2,diss}$$