



A. JAMES CLARK  
SCHOOL OF ENGINEERING



# Mechanical Engineering Design Day

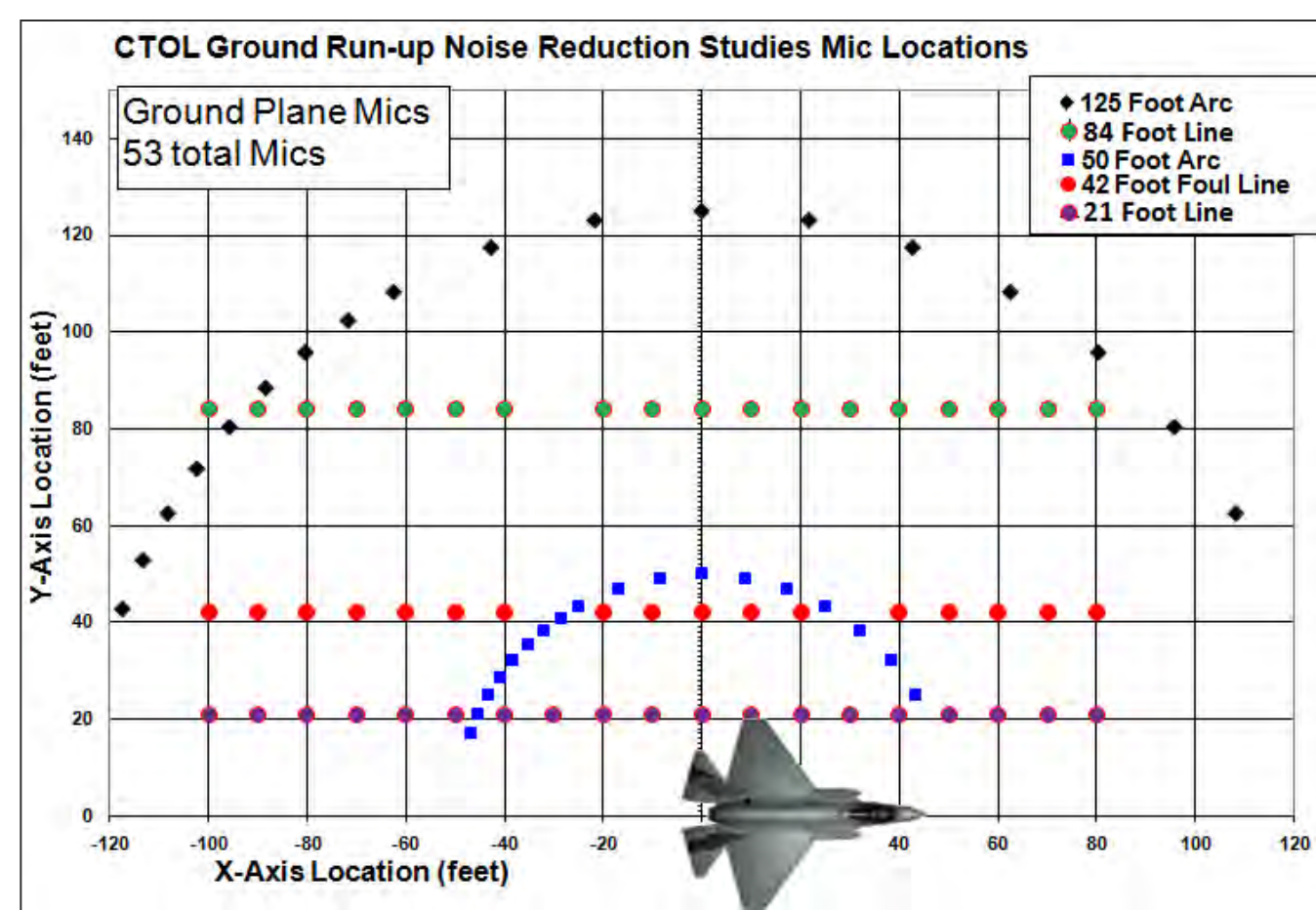
Date: November 30, 2010

## DeciBelators

David Chang John Farnese Elizabeth LeBrun Gary Showalter Hank Smith

### Objective

- Navy currently has no means of characterizing noise source for jet engines (recognized need Nov 2009)
- Currently involved in an American National Standards Institute (ANSI) working group to develop a jet noise measurement standard
- NAVAIR wants to acquire the equipment and lab facilities necessary to perform this testing according to the standard



### Customer Requirements

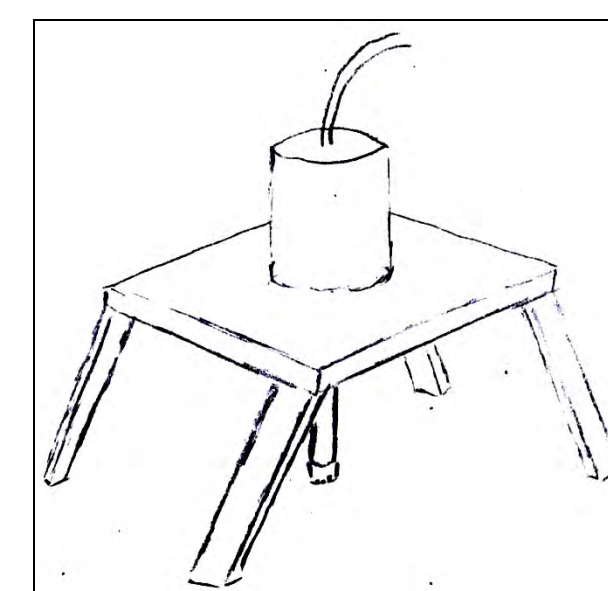
- Sturdy
- Durable
- Space-Saving
- Height adjustable
- Damping
- Quick setup
- Mic accuracy
- Rustproof

### Engineering Characteristics

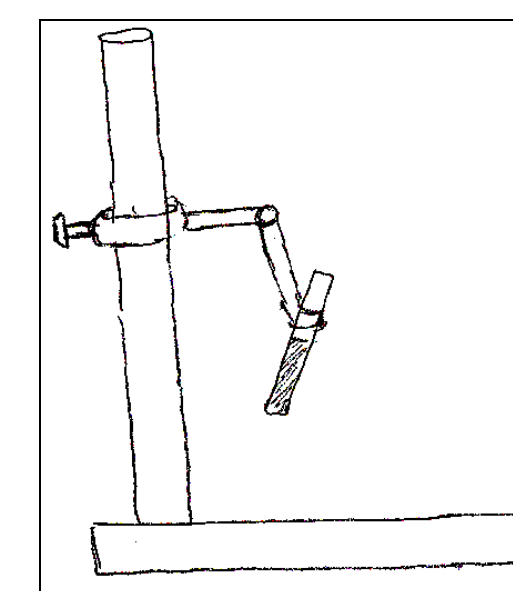
- Force holding mic
- Force to release mic
- Area of base
- Height of device
- Tipping moment
- Resonance freq
- DOF of mic
- Mic accuracy



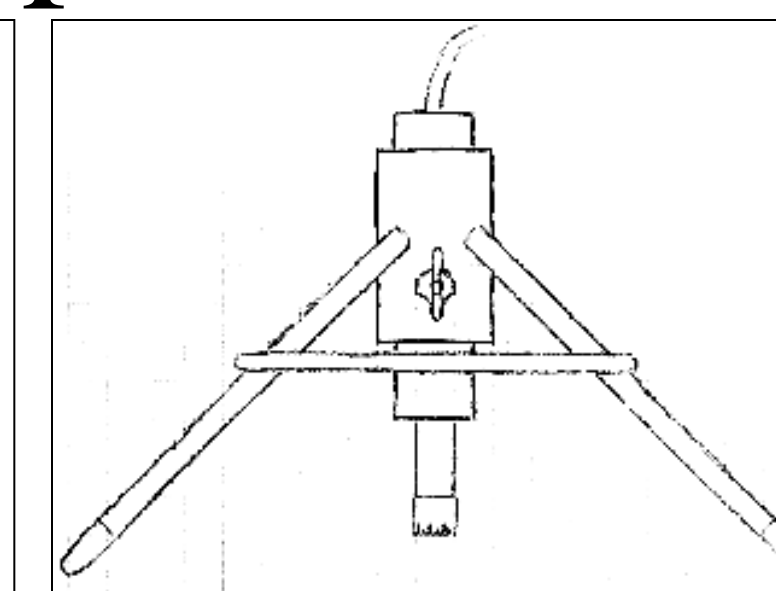
### Concept Generation



4-Leg Fold Up  
**Pros:** Foldable  
**Cons:** No mic adjustability  
Unstable

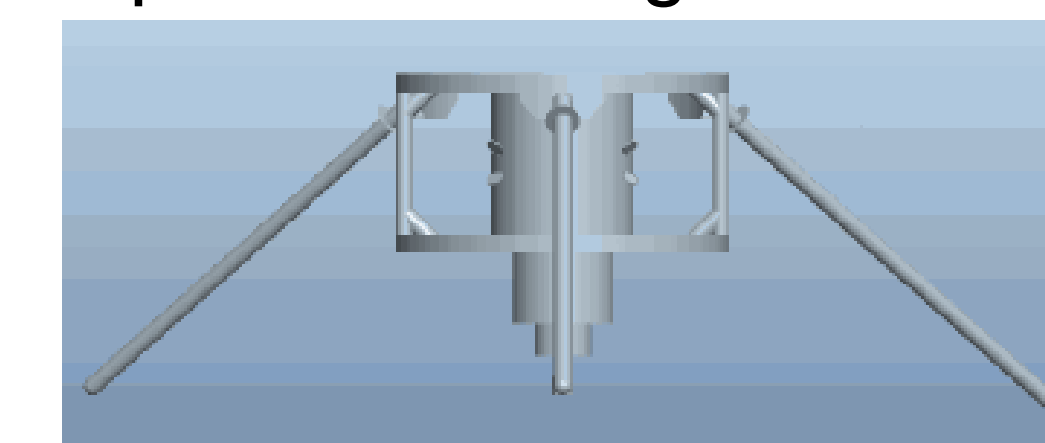


Chemistry Stand  
**Pros:** Degrees of Freedom  
**Cons:** Unstable  
Storage problem



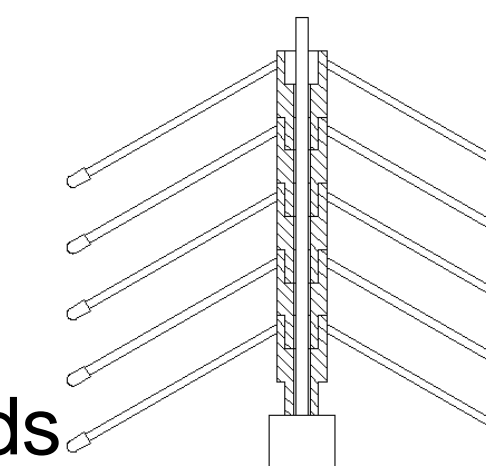
Tripod  
**Pros:** Light weight  
Stackable  
**Cons:** No damping

**Final Concept:**  
Tripod with added damping in microphone housing

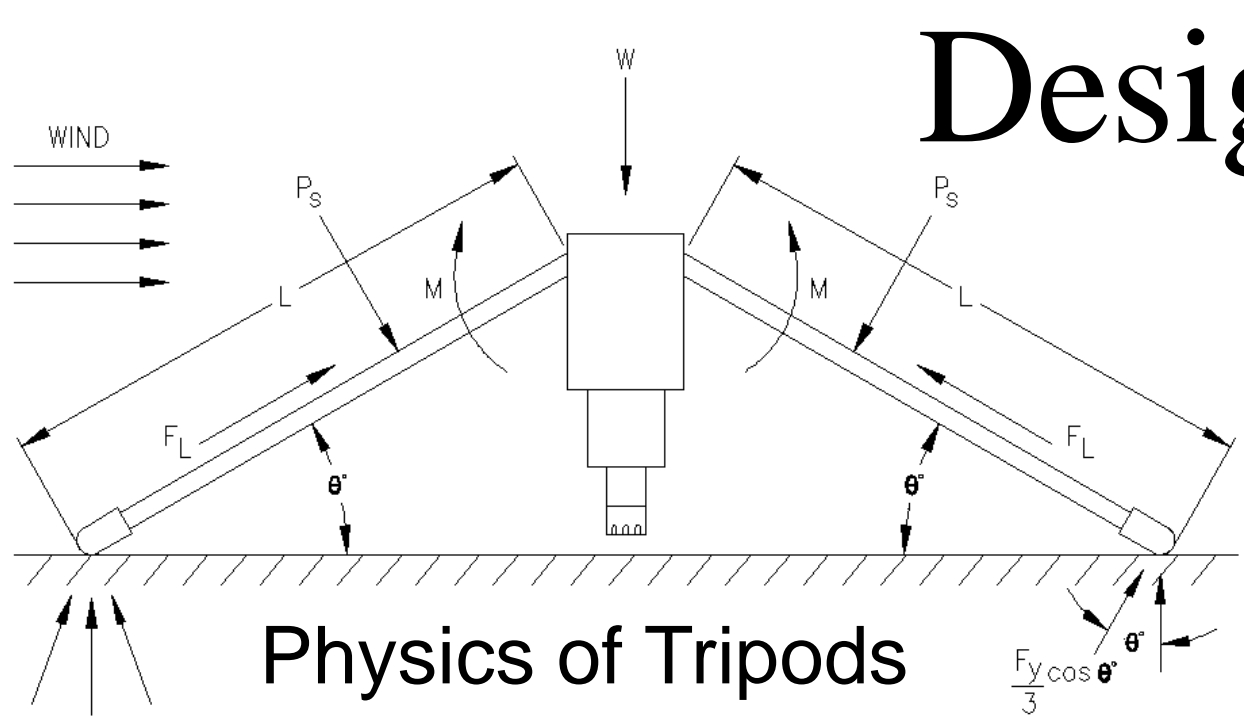


Design Characteristics	Weight
Minimal Distance between Legs (Interference)	0.24
Area of Base	0.19
Stackable	0.16
Damping	0.28
Microphone Adjustability	0.13

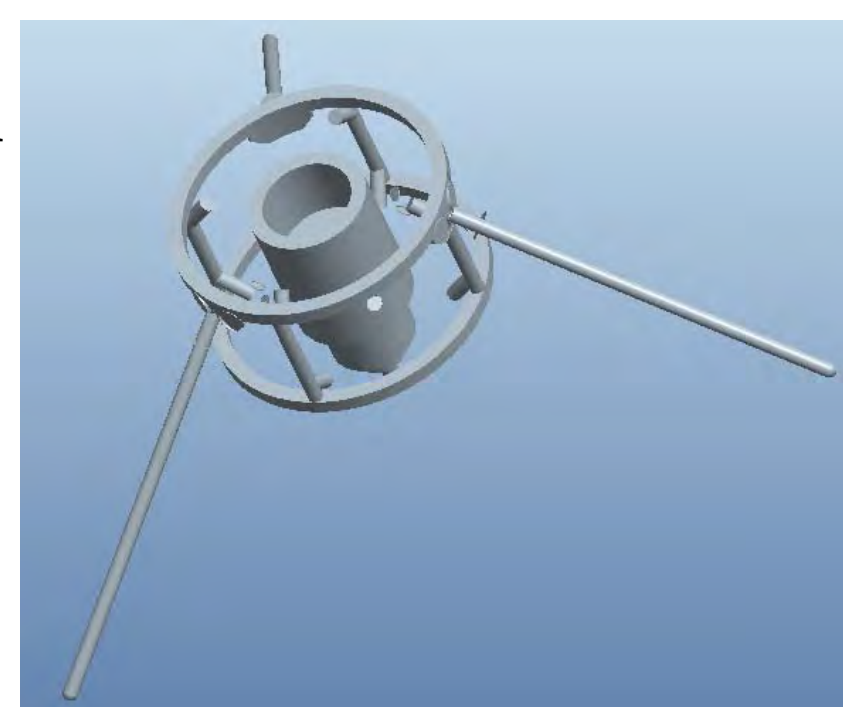
Stacked Tripods



### Design



- Any surface vibrations will transmit through the stand to the microphone generating noise when recording.
- The use of a shock mount isolates the microphone from the stand, mitigating any surface vibrations prior to reaching the microphone.
- The shock mount tripod meets the customer needs through its design and functionality. Sufficient damping helps to reduce vibration being transmitted to the microphone. The overall assembled design is durable, sturdy, and space-saving since it is able to be stacked during storage and transit.



### Prototype and Testing



Prototype evolution



### Conclusions

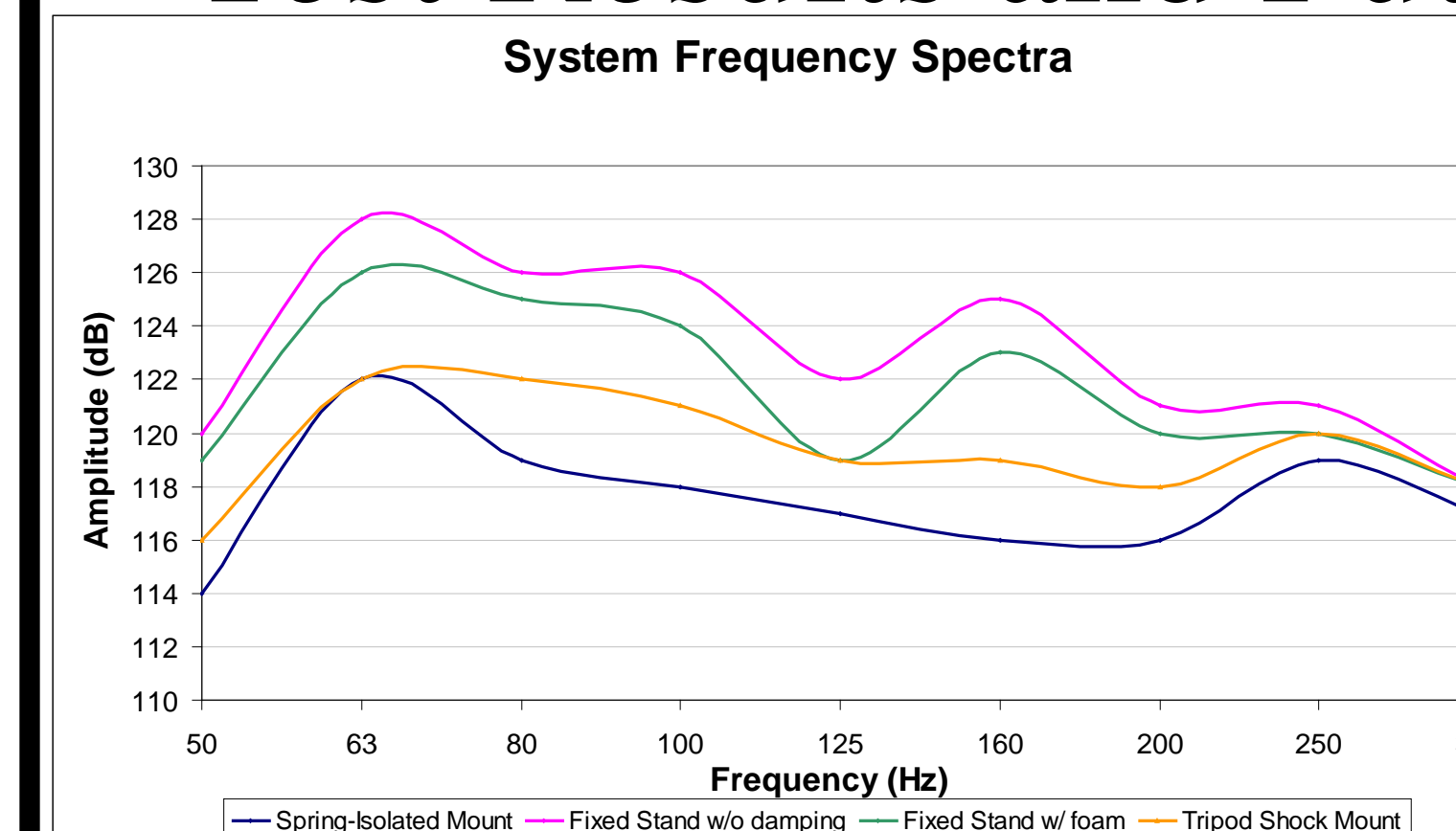
- The tripod shock mount helps mitigate the two resonance peaks center about 100Hz and 160Hz
- Smoother frequency response will allow for a simpler transfer function to correct data



### Setup

- Used speaker array to generate pink noise (equal power in all octaves)
- Pink noise at high sound pressure levels simulates jet engine noise
- Microphones set up as would be in application
- Data recorded for post octave-band analysis

### Test Results and Future Work



Main resonance affects occur between 50 Hz and 315 Hz. Tripod shock mount design smoothes out the resonance peaks in this region.

### Recommendation for future design

- Manufacture a complete set of 100 microphone stands to be able to complete Navy Jet Noise Measurement testing.
- Manufacture multiple sets for military bases world wide.

### Process reflection

- Creating life size prototypes really helped the team to visualize and test the design concepts
- Being able to simulate real world testing of prototypes along with help from AHP allowed for a final concept to be selected