



# Around the Kitchen Table

Presented by



## “New Tech, Fun Tech, Next Tech” Projects

October 27, 2011

5:30 – Meet and Greet

5:45 – Student Presentations

6:15 – Dinner Buffet

6:30 – Dinner Discussions



**Team CADET:**

Customizable Accelerator-Decelerator  
Equipment Tester



# Team CADET



**Autumn Allen**

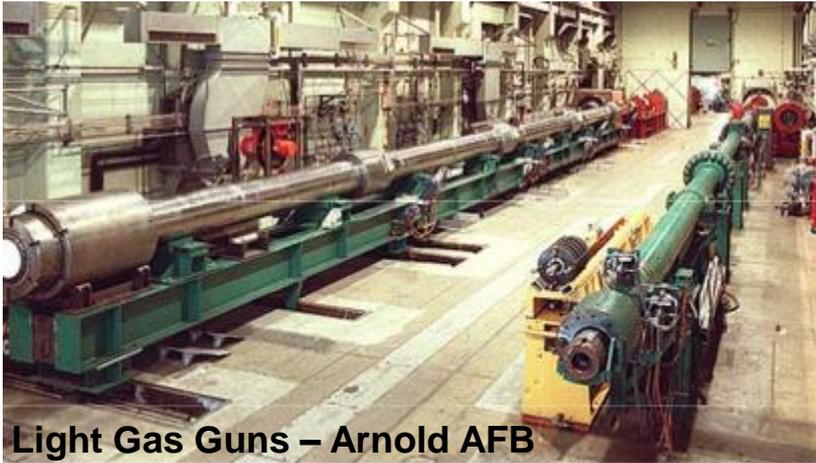
**Duncan Eddy**

**John Stretton**

**William Li**

**Tremayne Kaseman**

# Current Methods



Light Gas Guns – Arnold AFB

## Pros:

- Attain acceleration magnitudes
- Established testing procedures

## Cons:

- Inherently destructive
- Non-repeatable test environments



Cannon Testing at Eglin AFB

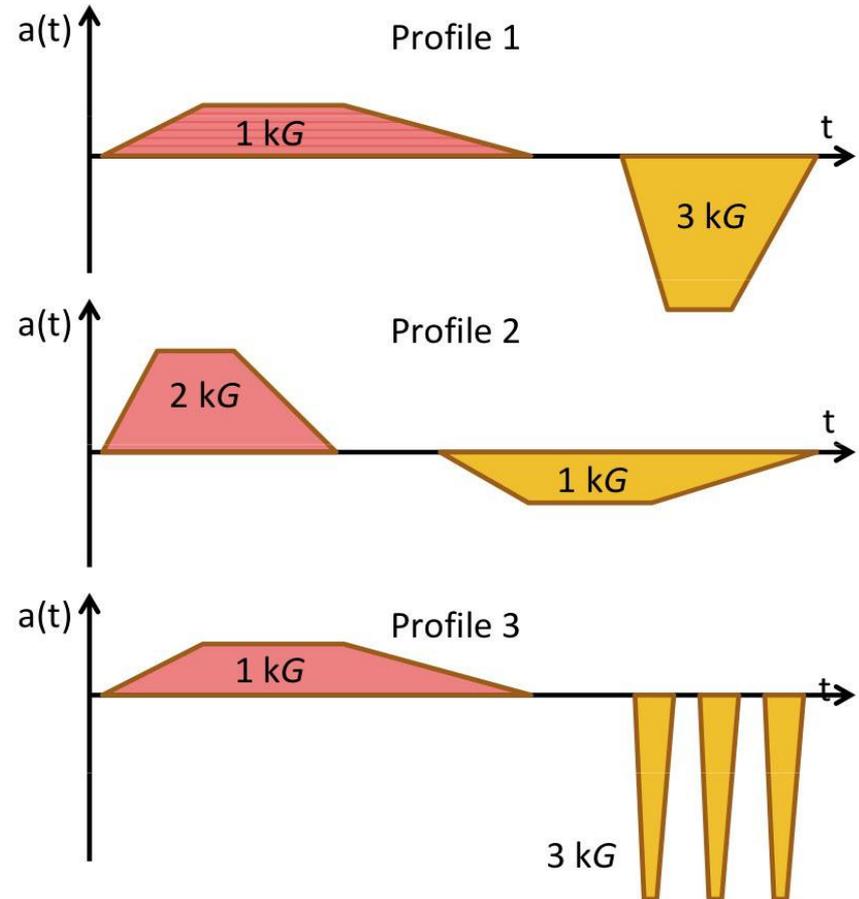
# Criteria To Guide Us

## Requirements:

- Variable Profiles (See Right):  
1-10 ms, 500-5000g
- Repeatable
- Customizable
- Scalable

## Optional Goals:

- Multiple Deceleration Pulses
- Controllable Rise Times



# Solution Preview

Two Stage Acceleration:



Combination of springs and  
pitching machine

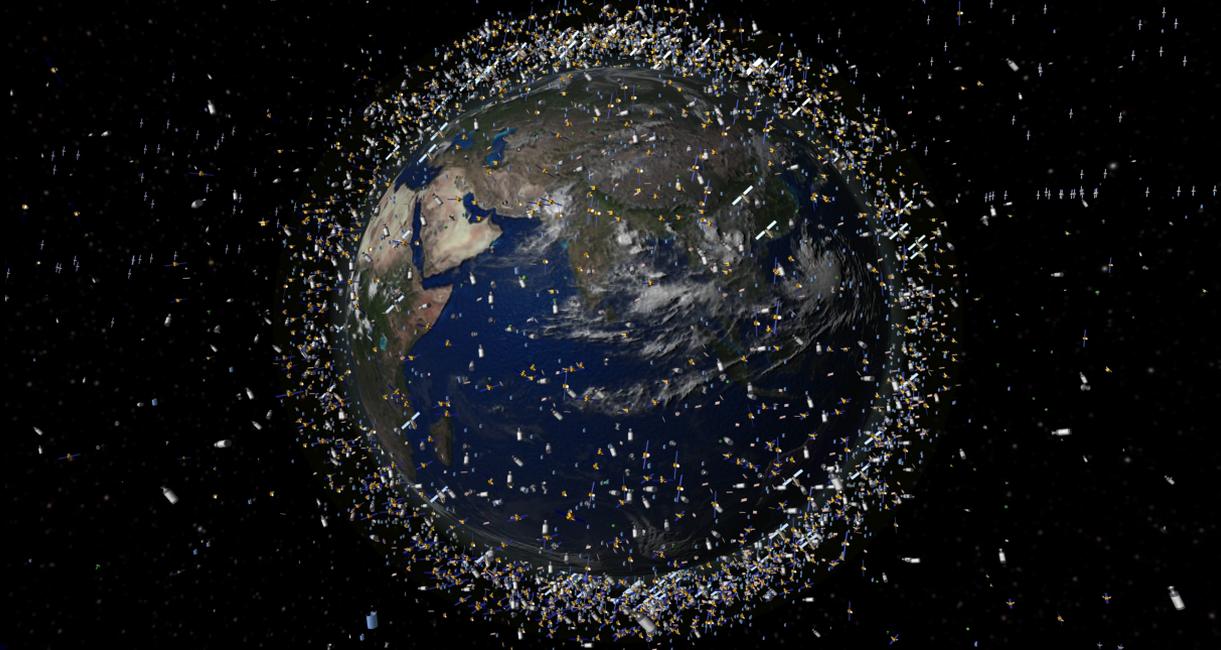
Single Stage Deceleration:



High velocity water

**Team CAAM Orbital Debris:**  
Model orbital debris and  
LEO/GEO collisions

# Orbital Debris Simulation



John Vogelgesang

Yulie Suzuki

Katja Sadlowski

*Dr. Mark Embree, Advisor*

# Space Trash

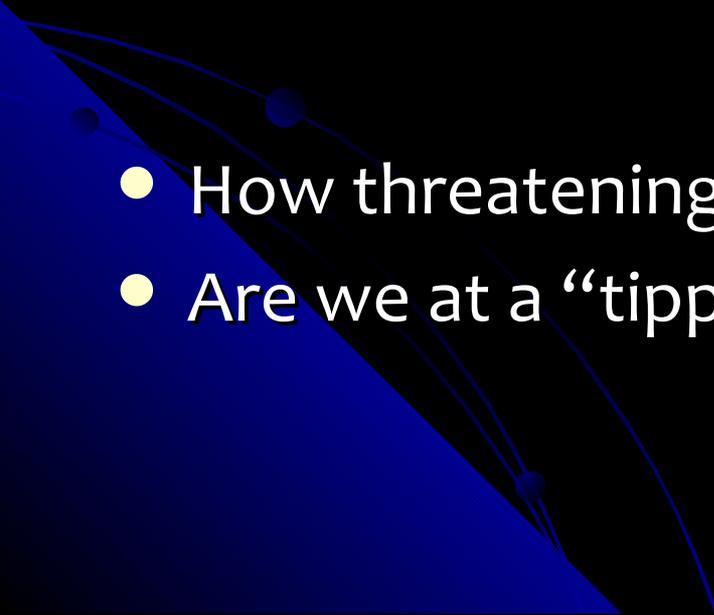
- 500,000 debris objects larger than 1cm in orbit
  - Average velocity 35000 km/hr
- Threat to space missions
  - 1991 Atlantis shuttle emergency reroute
- Threat of re-entry
  - 16,000 recorded debris re-entries in 40 years
  - 1 human struck

Lawrence D. Roberts, Addressing the Problem of Orbital Space Debris: Combining International Regulatory and Liability Regimes, 15 B.C. Int'l Comp. L. Rev. 51 (1992),

"Space Shuttle Dodges Debris From Rocket." The New York Times. November 29, 1991: <http://www.nytimes.com/1991/11/29/us/space-shuttle-dodges-debris-from-rocket.html>} Had this impact occurred, the shuttle could have been destroyed or seriously damaged

Greenfieldboyce, Nell. "Where Falling Satellite Lands Is Anyone's Guess" <http://www.npr.org/2011/09/21/140641362/where-falling-satellite-lands-is-anyones-guess>

# Problem Statement

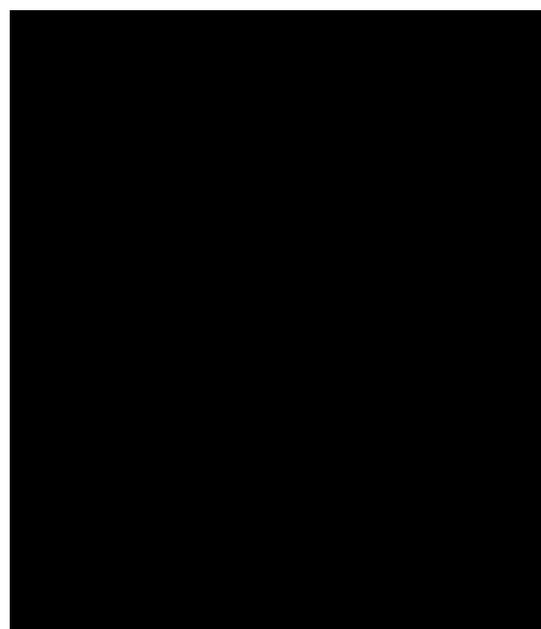
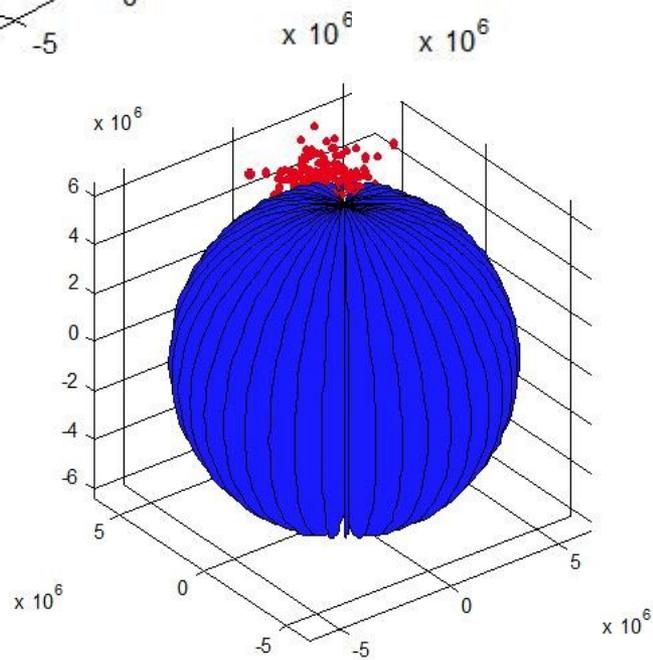
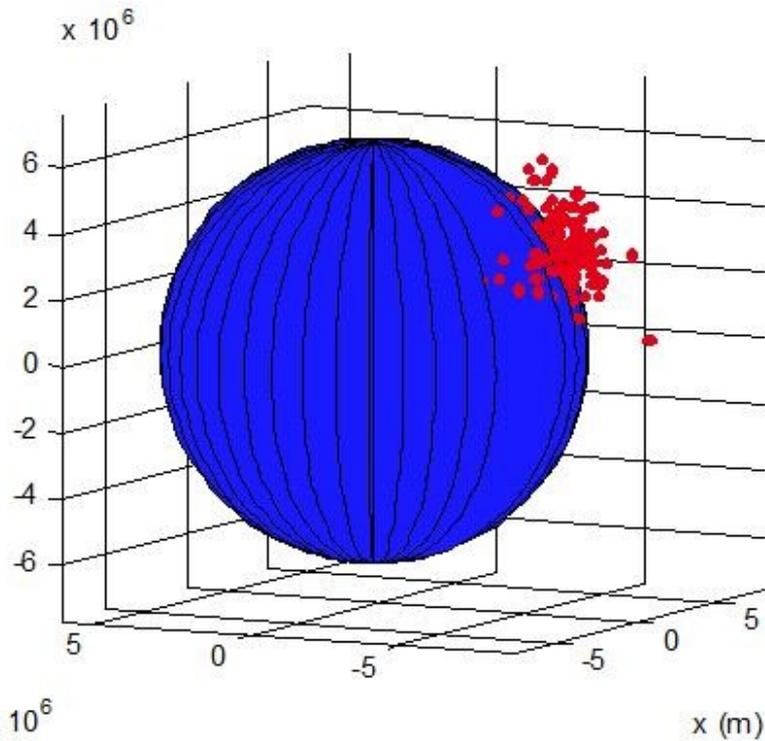
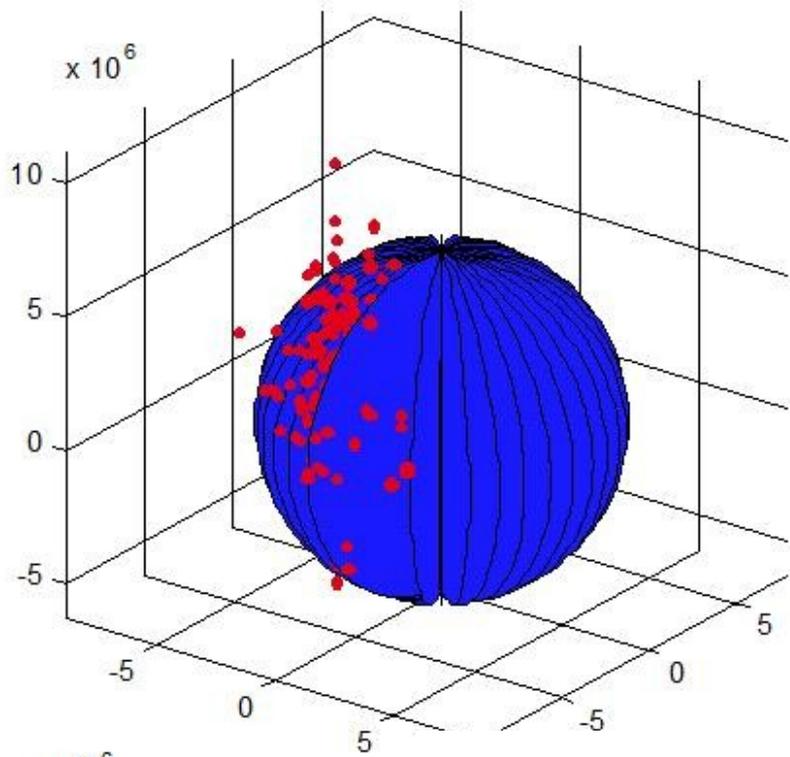
- Model debris events in low earth orbit (~1000 km) and geosynchronous earth orbit (~30000 km).
  - Simulate collisions between debris and satellites
    - Assess debris accumulation and behavior thereafter
  - How threatening are LEO/GEO events?
  - Are we at a “tipping point”?
- 

# Model Criteria

- Numerical Accuracy
  - 95% of truth or better
  - Must see convergence under low tolerances
- Model will run in MATLAB in 12 hours or less overnight
- Populations of 20,000-100,000 objects
  - Greater than 10 cm in diameter.
- Adaptable event modeling: implosions, kinetic kill vehicle impact, collisions.

# Approach

- Orbital integration via *MATLAB*.
- Start from a simple model, approaching a real-world situation.
  - Atmospheric drag
  - Lunar, solar gravity
- Model events via probability distribution sampling.
- Input various debris populations and record behavior, collisions, and accumulation.



**Team Microwave:**  
Microwave Imaging System

# A Novel

## Imaging System

Stephen Crowe

Michelle Jin

Nnena Okeke

Eddie Reyes

# Truth About Breast Cancer

- 3rd deadliest cancer
- 2nd most diagnosed cancer
- Receives most funding
- Women have 1 in 8 chance of being diagnosed
- NCI estimates 230,480 new cases and 39,250 deaths in women in 2011



# The Mammogram

## ➤ All X-Ray Imaging is Imperfect

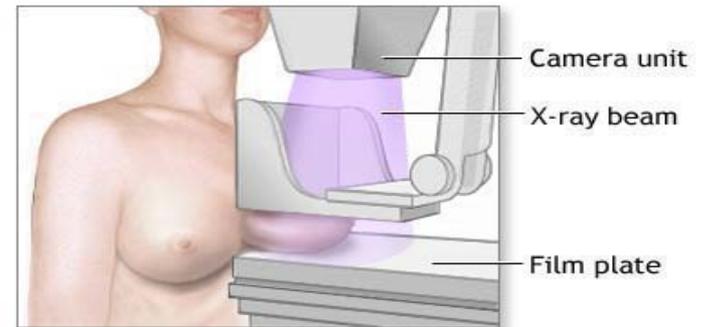
Matter Scatters the Trajectory of Many of the X-Rays

Results in Poor Contrast and a Need for Compression

## ➤ Frequent False Negatives

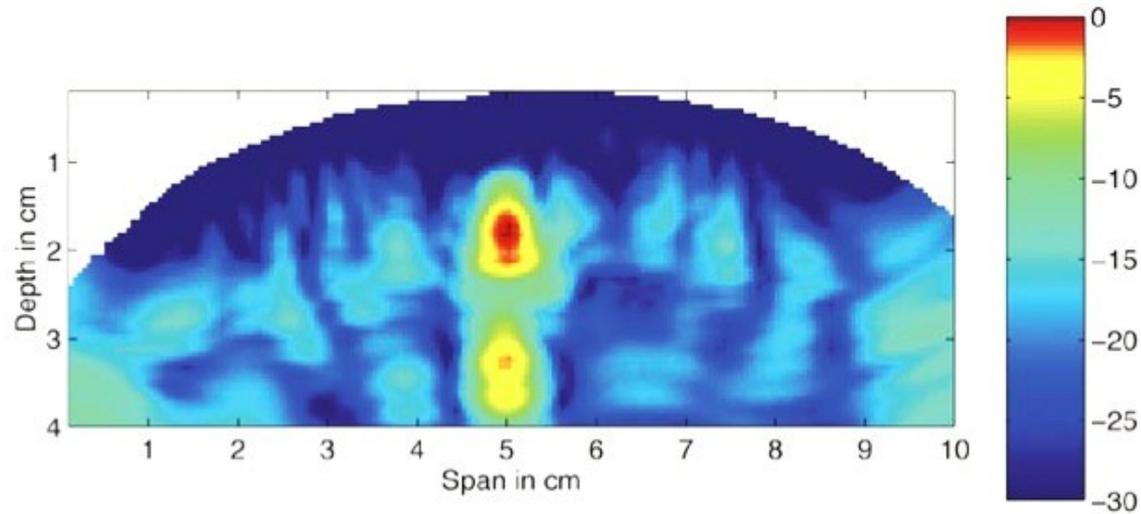
National Cancer Institute estimates 1 in 5.

Results from Similar Densities in Normal  
and Malignant Tissue



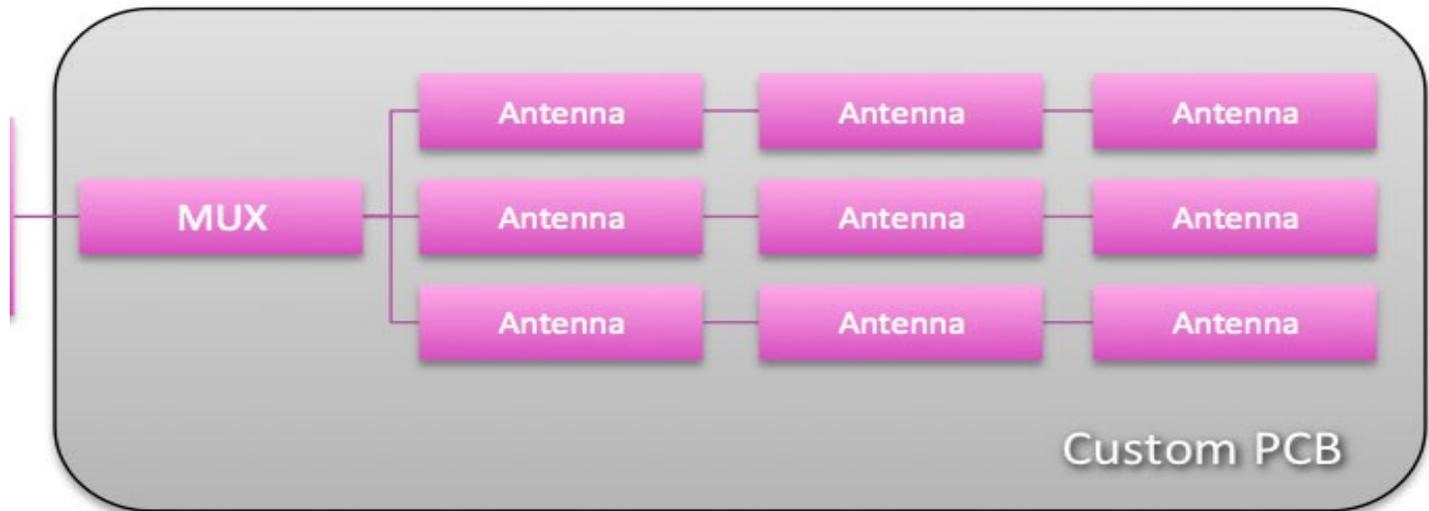
In mammography, each breast is compressed horizontally, then obliquely and an x-ray is taken of each position

# The Images



Resolution	5mm
Contrast	Ability to detect 10% dielectric difference

# The System



Planar Antennas	On-board antennas only, no external components or structures
Frequency Range	1Ghz to 10Ghz
Safe for Medical Use	Meets microwave exposure standards

# Potential Antenna Designs

## ➤ PCB Traces-planar antennas

➤ Dipole

➤ Loop

➤ Patch

➤ Slot

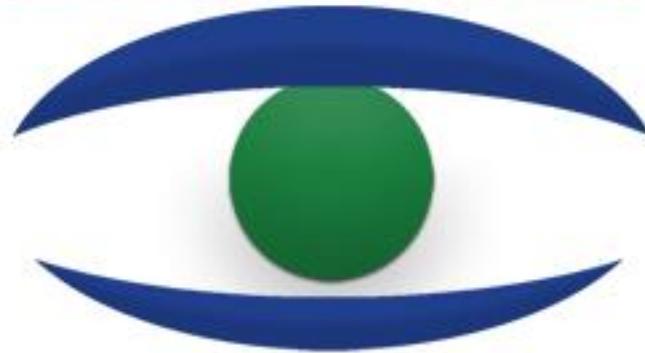
# The Big Picture

- Designing a new breast cancer screener.
- Research shows dielectric constants of breast tissues vary significantly at microwave frequencies.
- Use a 2D antenna array and a network analyzer to image dielectric composition of the breast.

**Team mobileVision:**

Two-part vision screening system

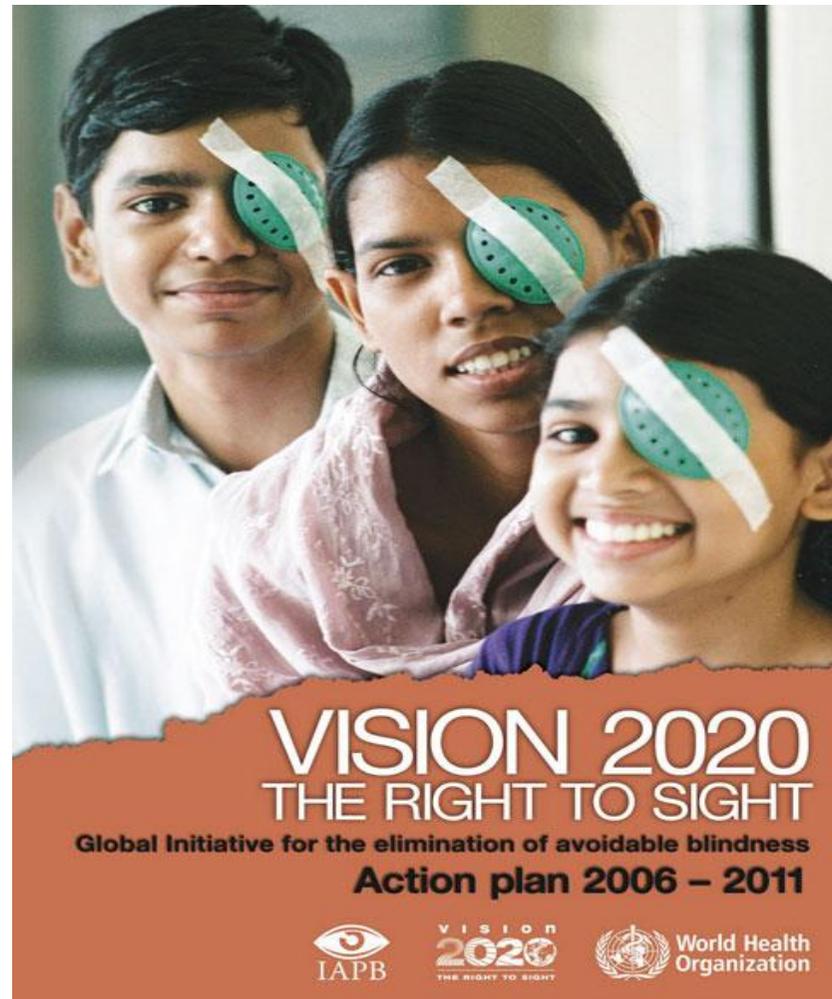
# mobileVision



Kevin Beale, George Chen  
Richard Latimer, Minhee Park, Adam Samaniego

Faculty mentors: Dr. Ashu Sabharwal,  
Dr. Ashok Veeraraghavan, Dr. Gary Woods

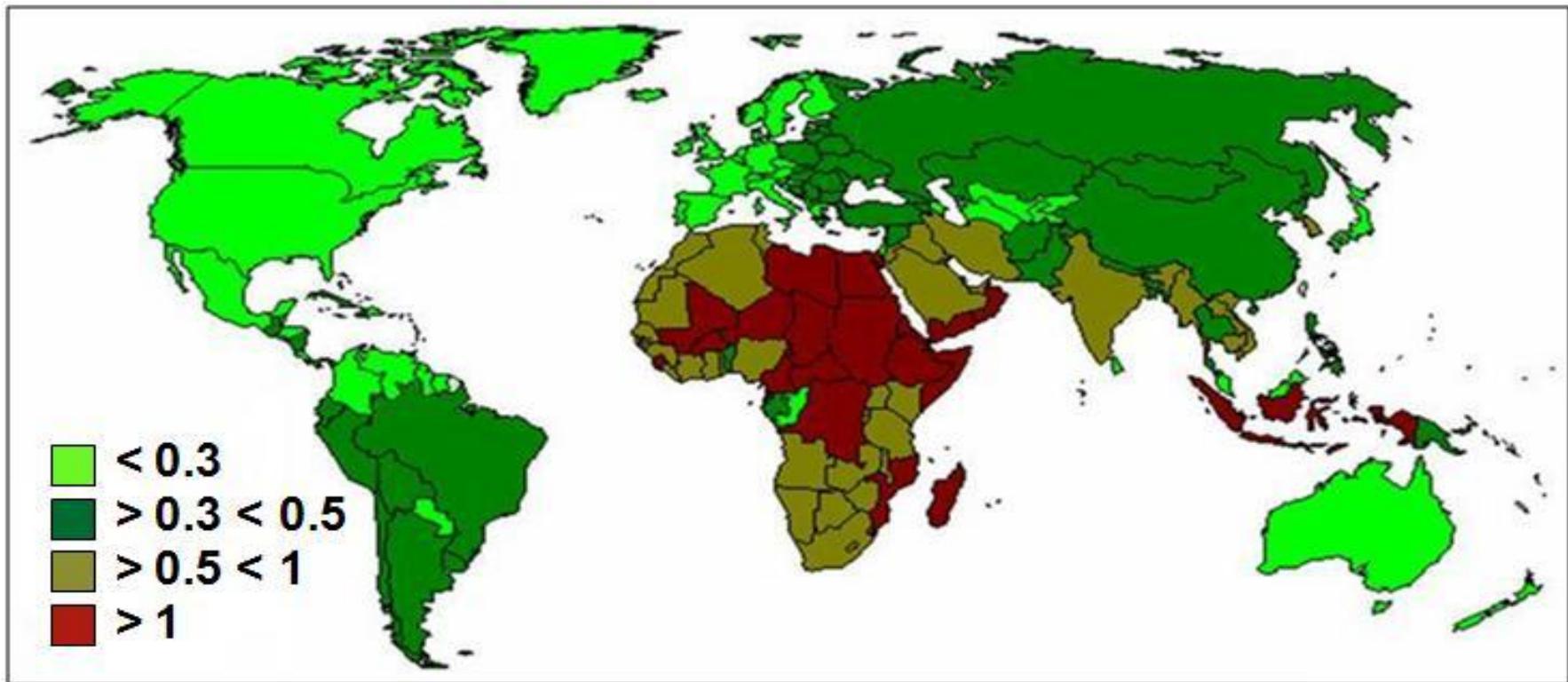
Every **5 seconds**,  
one person in the world goes **blind**.



# Worldwide Optical Health

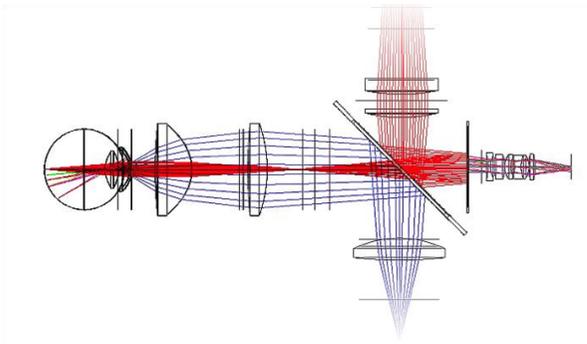
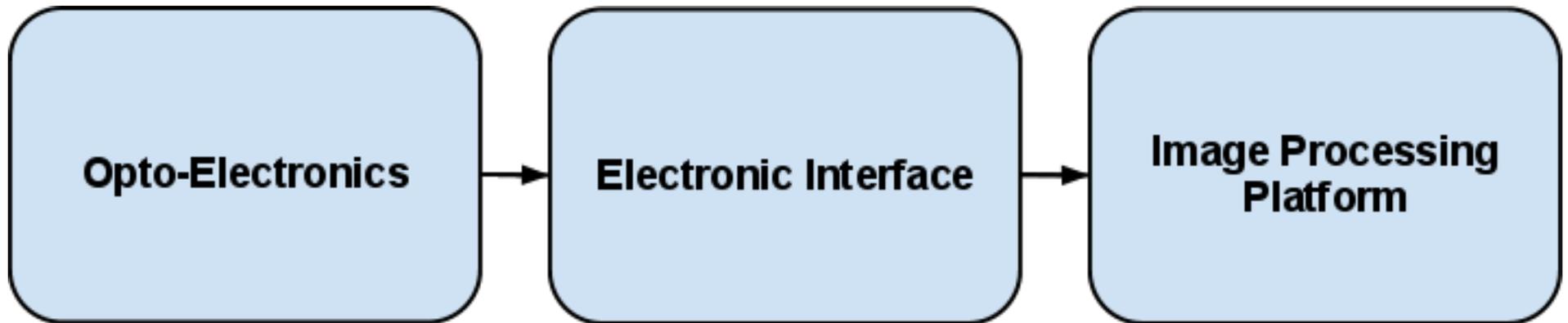
- 284 million people are visually impaired
- 90% of cases are in developing countries

## Blind Distribution



# The MobileVision Solution

***A portable, easy-to-use, cost-effective optometric system for the developing world that can detect the most common visual impairments.***



# Autorefractor

Uses structured IR illumination to measure

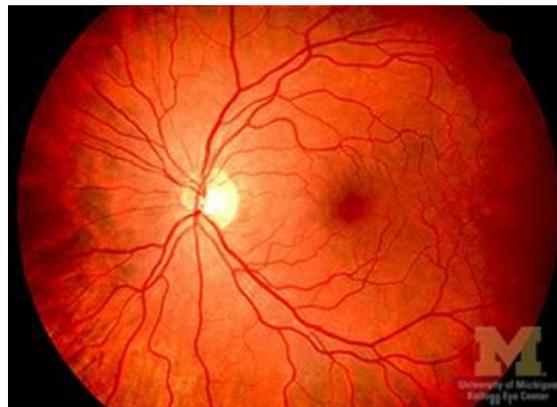
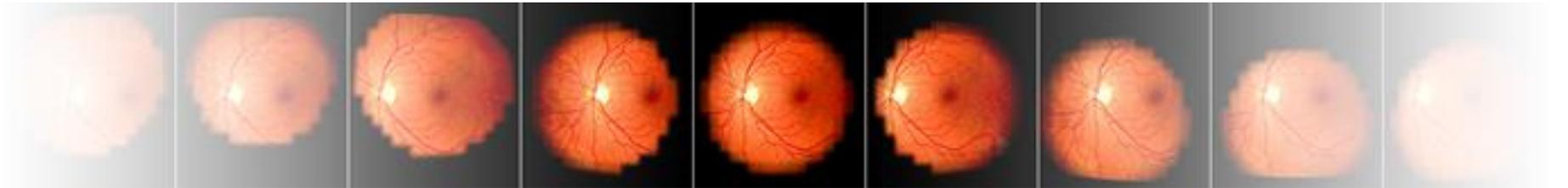
- Refractive error
  - In range [-8D, +5D]
  - 0.5D resolution
- Astigmatism

# Retinal Imager

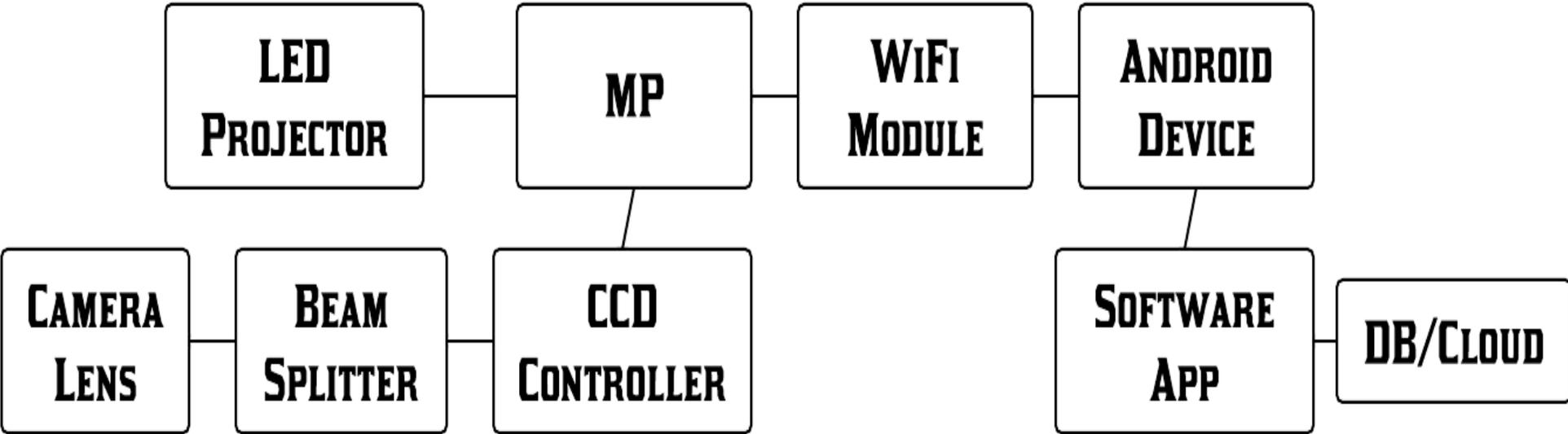
Image the ocular retina

- Over 70 degree field of view
- Resolve 50 micron structures

Image stitching for greater resolution

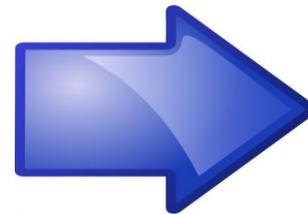


# System Design



# mobileVision

- Mobile system for eye health
  - Autorefractor
  - Retinal imager
  - Supporting hardware, software
- Portable, scalable, easy-to-use



# **Team “Stressed” Out Seniors: Wet-Environment Stress Tester**

# Wet-Environment Stress Tester

Around the Kitchen Table Presentation  
10/27/2011

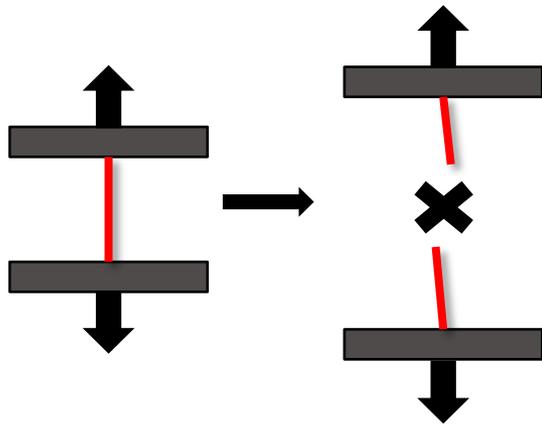
Louis Chen  
Valerie Li  
Robby Palm  
Ronak Patel  
Alex Thompson



**TEAM SOS**

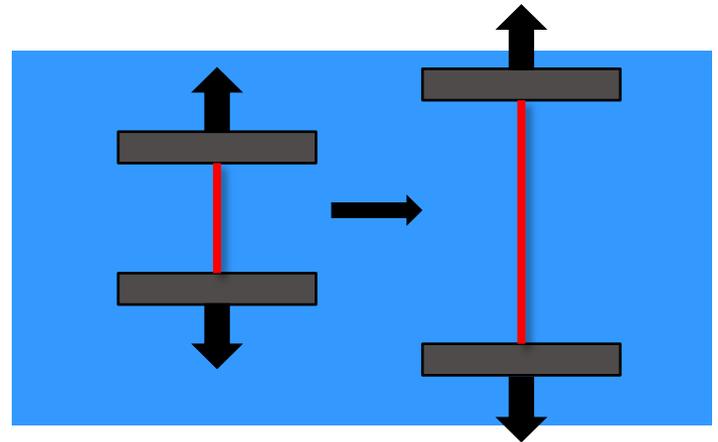
## Design Challenge:

- ❖ There are no instruments that accommodate tensile testing in wet environments
- ❖ For materials native to wet environments, current “dry” testing tools are not appropriate



## Solution:

- ❖ Machine will closely mimic a material's native liquid operating environment
- ❖ System will provide high-quality mechanical property data at a competitive price

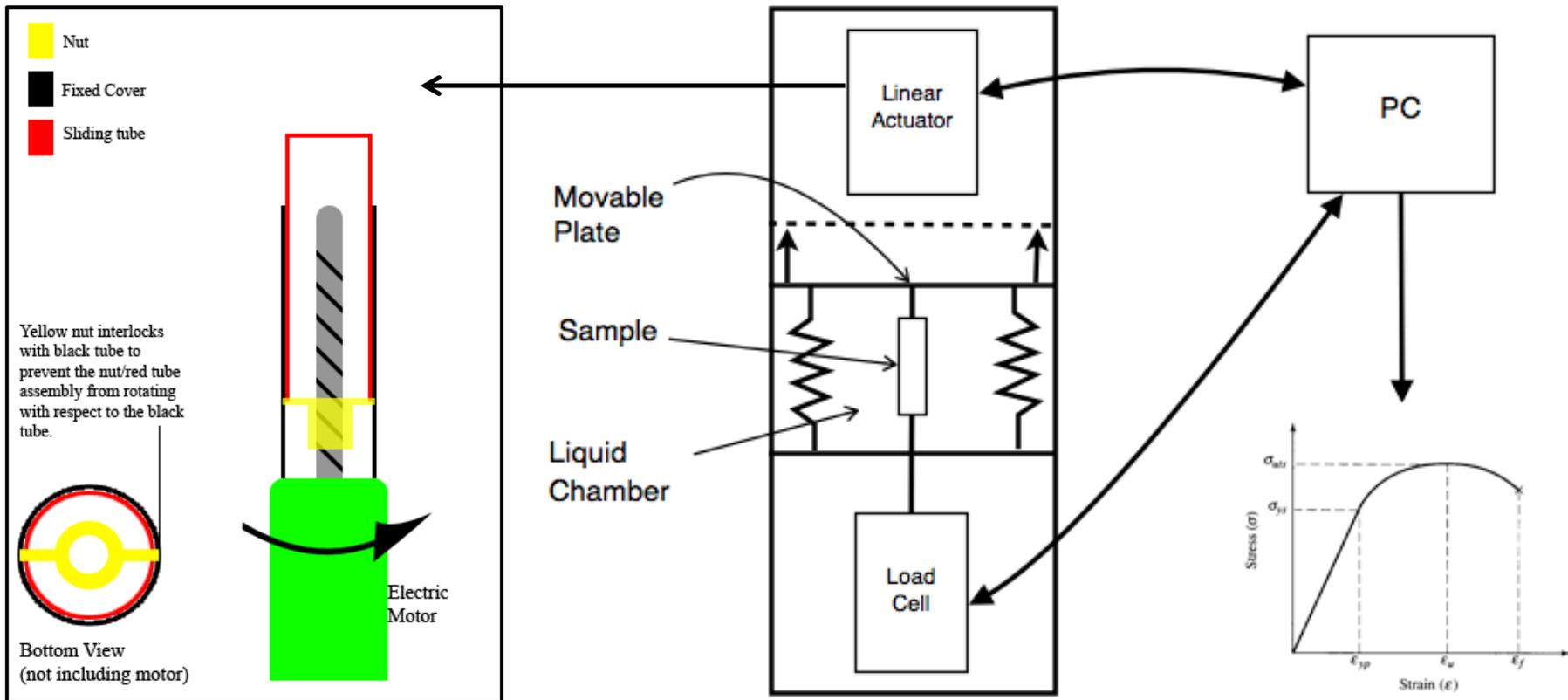


**TEAM SOS**

# Design Criteria Overview

Criteria	Constraints
Strength	All critical material must have a yield strength $> 1,000$ MPa
Size	Must fit on a standard lab table (i.e. 3' x 4')
Observability	Aquatic tank must have a viewable window for microscope
Cost	Final design must cost $< \$6,000$
Linear Actuator Range	1.5mm to 22mm
Actuator Step size/rate	100 nm / 1 $\mu$ m per sec
Eliminate unwanted forces	$<.001$ N

# Preliminary Approach





# Around the Kitchen Table

Presented by



# THANK YOU!

