



# MATHEMATICAL LEARNING THEORY

Autonomous Navigation of a MicroAerial Vehicles  
USC IMI



## MicroAerial Vehicle (MAV)

Uses:

- assess extent of a hazardous release using chemical and radiological sensors
- explore / map terrain in real time using a variety of sensors
- navigate in cluttered environments without maps
- battle assessment
- search
- track

Capabilities and Features:

- environmental and situational awareness
- flight control by video
- additional sensors for flight control:
  - accelerometers, gyros, and GPS
- maneuverability in urban and rural environments
- low cost to construct, operate, and maintain

## IMI Researchers

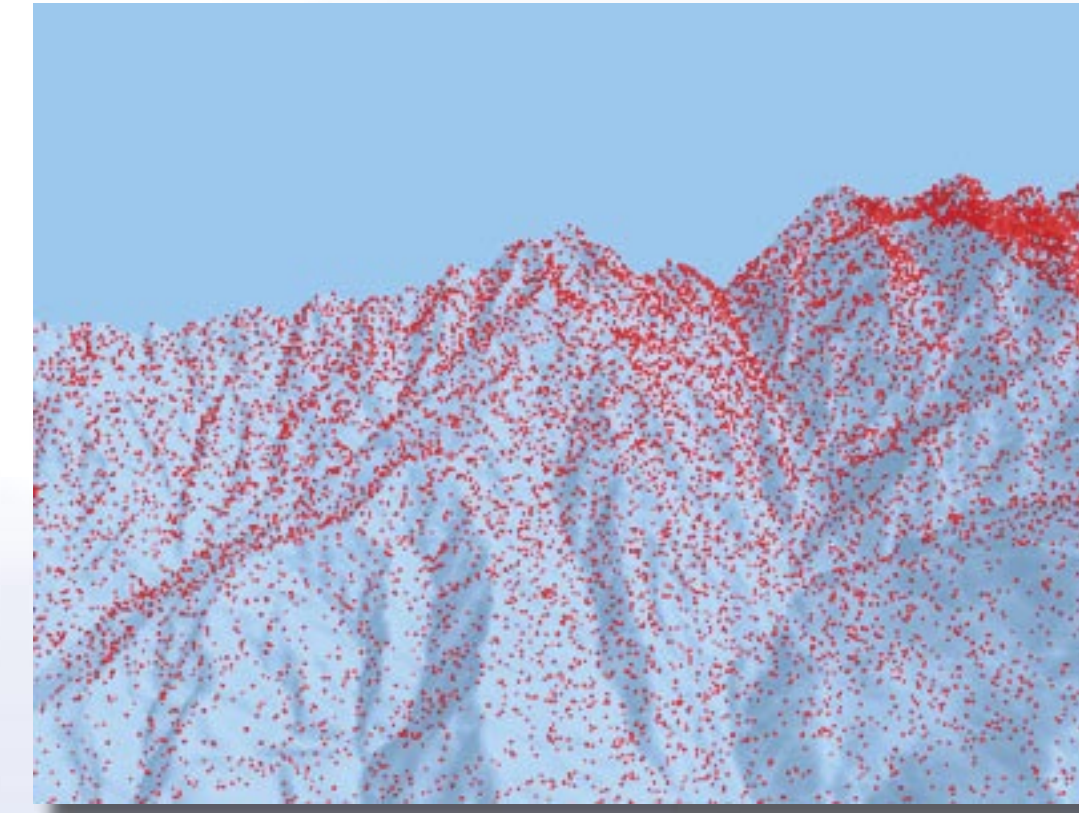
Faculty: P. Binev, R. DeVore, R. Sharpley, V. Temlyakov  
Staff: M. Hielsberg, L. S. Johnson

## Collaborating Institutions

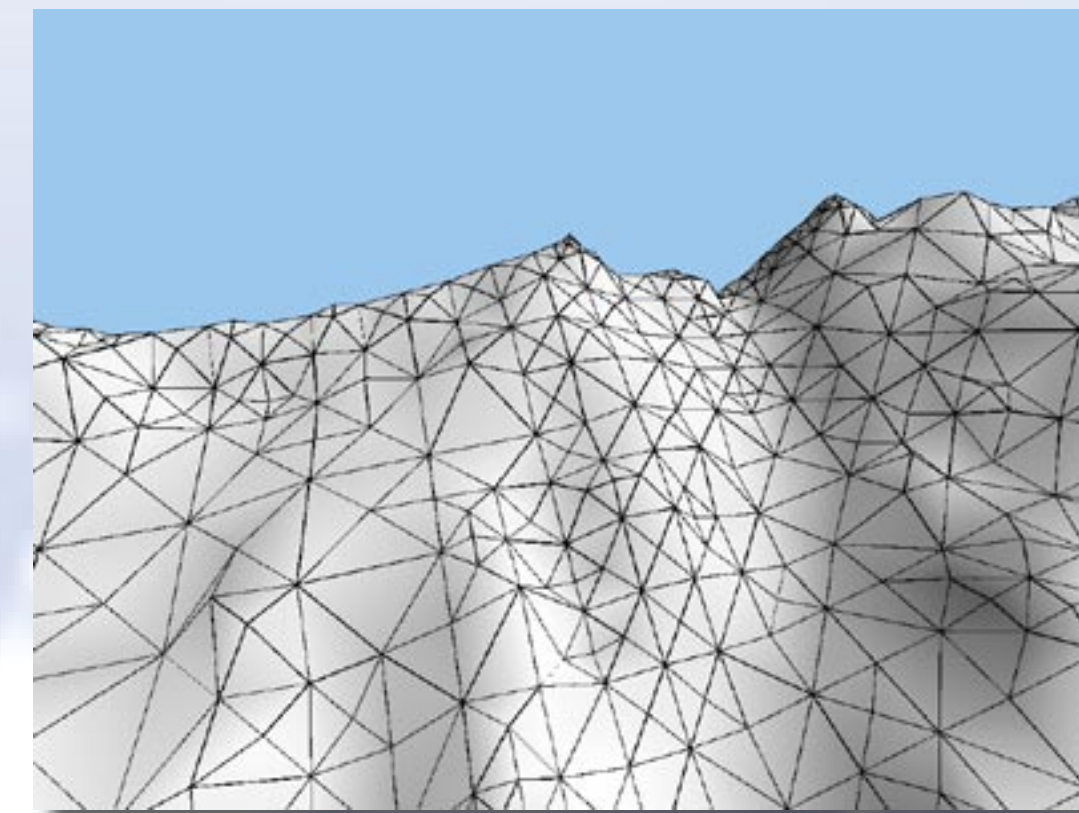
University of Florida – Mechanical & Aeronautical Engineering Departments  
Carnegie Mellon University – Robotics Institute  
Eglin AFB

## Learning (mapping)

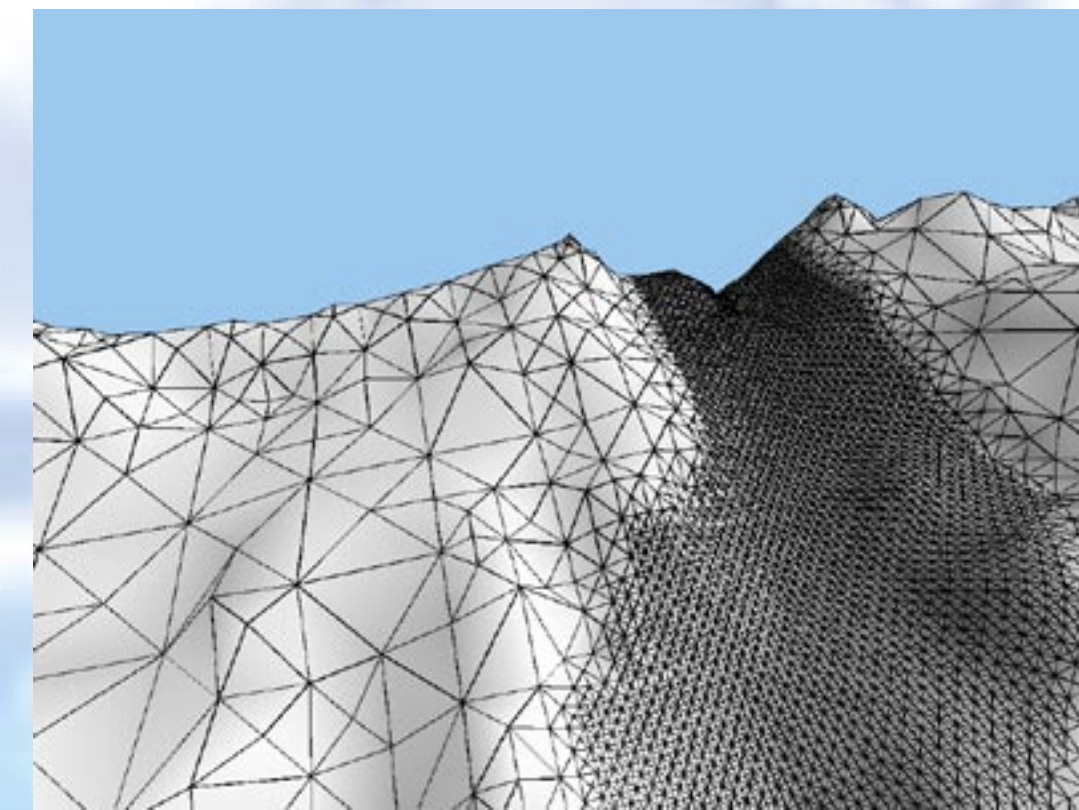
Cloud of points sensed from video during flight.



Learning theory application adaptively constructs a triangulation for assimilated surface.

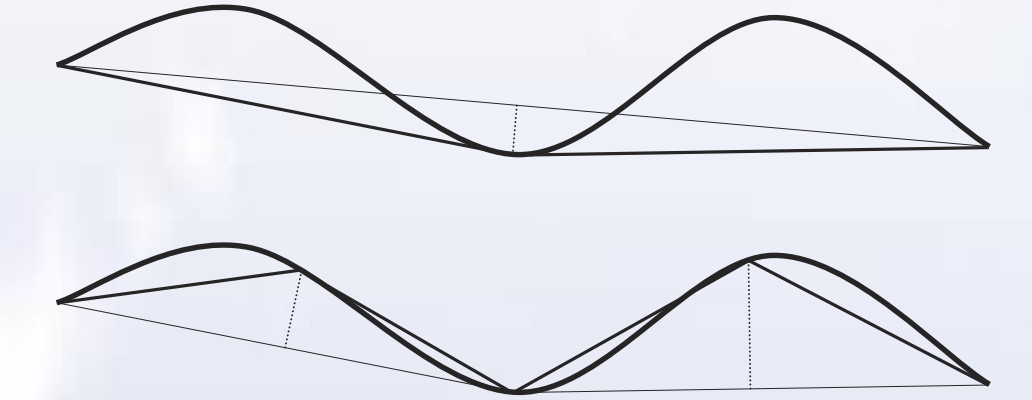
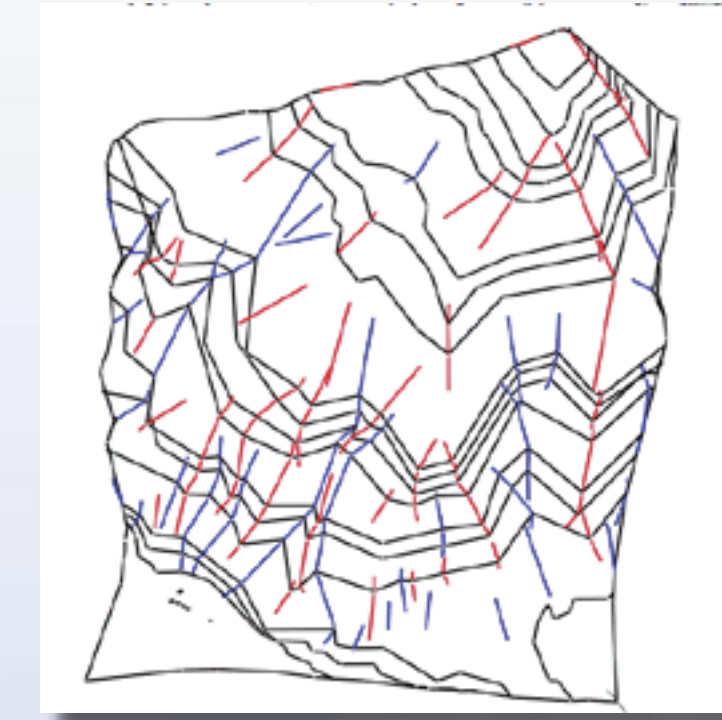


The triangulation and associated local statistics are used to construct an assimilated surface in a multiple-resolution framework. On-line computations of redundant data enable sub-pixel accuracy.



## Contour Encoding

Build Morse Structure with prioritization of geometric feature classes.



Multiresolution Analysis of Curves

## Automated Flight Control

Mathematical Learning to be employed to

- automatically calibrate trim for newly fabricated or damaged microaerial vehicles
- real-time learning of response to actuation of control surfaces

## Contact

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