

## 1. What is a flying robot?

Working definition: any unmanned, airborne vehicle. Includes:

- airplanes, like the Predator
- blimps, like Plantraco kit
- micro air vehicles (MAVs), like those below



Unmanned airplane uses GPS to navigate



Plantraco Blimp

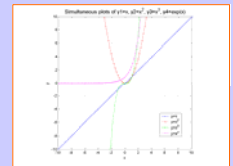
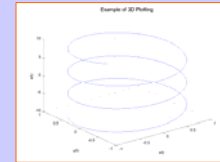


First, second and third generation micro air vehicles

## 2. First Steps to Robot Vision (and the math I needed to learn)

### 1. Basic Matlab operations

- manipulating vectors and matrices
    - add and subtract matrices
    - multiply matrices
    - programmatically flip columns
  - plotting graphs, simultaneous and 3D
- ### 2. Introduction to image processing
- convert to grayscale
  - digitize to 256 shades of gray
  - can create negative, mirror and "threshold" images



Once an image is digitized, you can really go to town!



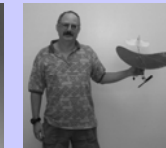
Original color



B&W 256 grayscale



Negative of image



Mirror image

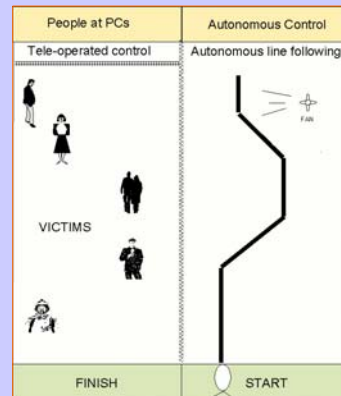


Image Threshold = 100

## 3. How can this be applied to computer vision?

1. Another math technique I learned was how to calculate the centroid of an image, so that the robot could be programmed to make the same calculation and use the information to steer. In the First Annual Indoor Aerial Robot competition to be held at Drexel in 2004-05, each team's flying robot will have to follow a known, marked course autonomously using similar calculations.

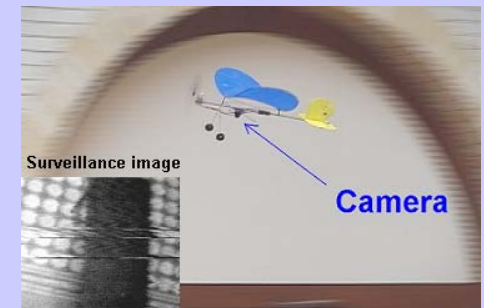
2. Another steering technique which can be programmed into robots starts with edge detection: a binarized image is fed to an array of photoreceptors. "White" receptors next to "black" receptors can be interpreted as an edge. The robot can use changes in the coordinates of the edge across successive images to steer.



## 4. What's next?

Goals for AP Computer Science this year include:

- Write a program that can "binarize" a grayscale image
- Write a program that takes the binary image and calculates its centroid
- Write a program that calculates the path of the centroid across successive images
- Write a program to "steer" based on this path
- Go see a flying robot competition!



Goal for me: write a program that will permit a robot to calculate distance using the images of two cameras (i.e., depth perception with stereo vision).