# Collision Avoidance Interface for Safe Piloting of Unmanned Vehicles using a Mobile Device

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## Collision and Obstacle Detection and Alerting (CODA) Display:

With this work, we take steps towards making MAV systems usable enough to operate safely, effectively, and consistently, and facilitate wider adoption of MAV technology

### Micro Aerial Vehicle (MAV)

- Originally referred to vehicles smaller than 6 inches in diameter
- Now refers to broader range of small aerial vehicles



Examples of Micro Aerial Vehicles

### Uses of MAVs

- Perform tasks that are unsafe or undesirable for humans to do themselves
- Investigate safety in nuclear reactors
- Assess structural damage to a building or bridge after an earthquake
- Find missing persons
- Monitor wildfires
- Perform local observation and surveillance tasks (battlefield, disaster area, or for scientific observation)

### Challenges for widespread adoption of MAVs:

- Training requirements for new operators
- Difficult to navigate in uncertain environment with unexpected obstacles



CODA display integrated in MAV-VUE interface, for use in navigating in an outdoor environment.
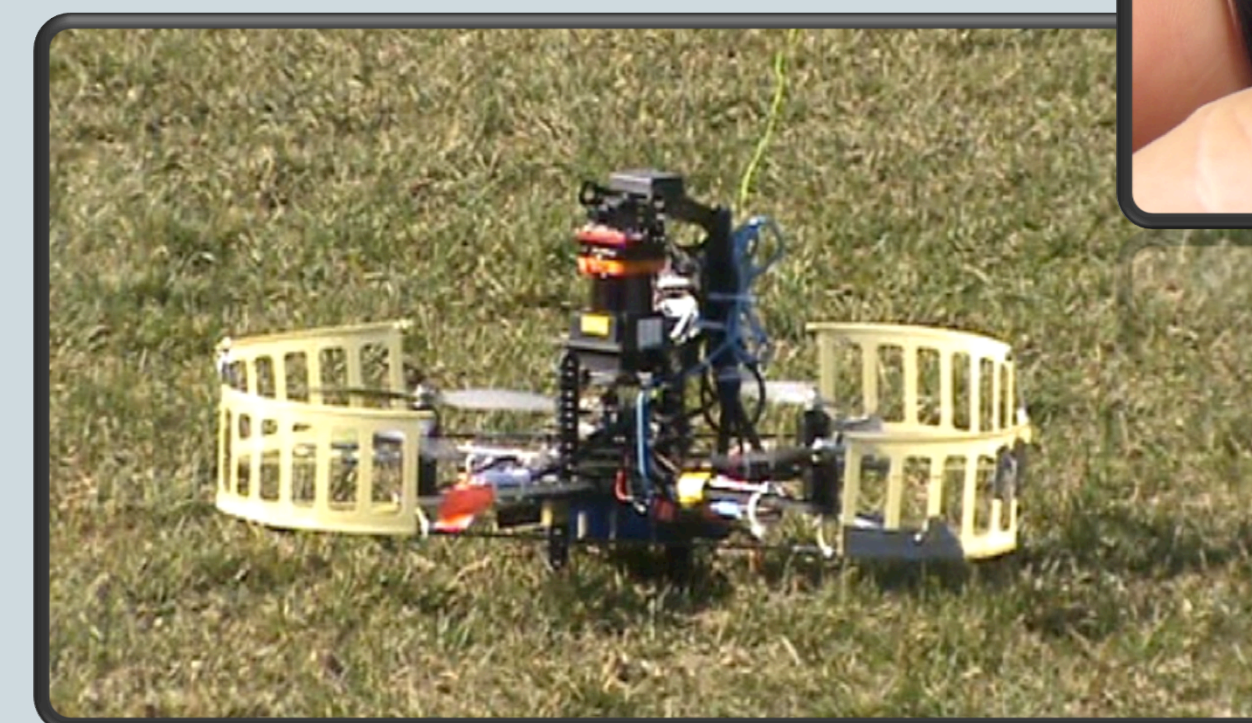
Pelican quadrotor vehicle used for outdoor flight demonstration (made by Ascending Technologies)

### Requirements

- Warn the user of potential collisions in the vicinity, both within and outside the field of view
- Show info about location and distance of obstacles
- Integrate with Micro Aerial Vehicle Visualization of Unexplored Environments (MAV-VUE) mobile display

### Haptic Feedback Design

- Triggered when the user enters the highest alert threshold, simultaneous with largest visual indicator
- Single vibration which occurs for 1.5 seconds



CODA indicator in simulated indoor hallway

### Visual Display Design

- **Triangle**: precisely indicates obstacle location
- **Arcs**: increase in size and salience as the distance to the obstacle decreases, without obscuring the main control interface
- Overlaid on the navigation circle, rather than at the edge of the screen, more central to the field of view.



Example Thresholds

Detection
Warning
Danger
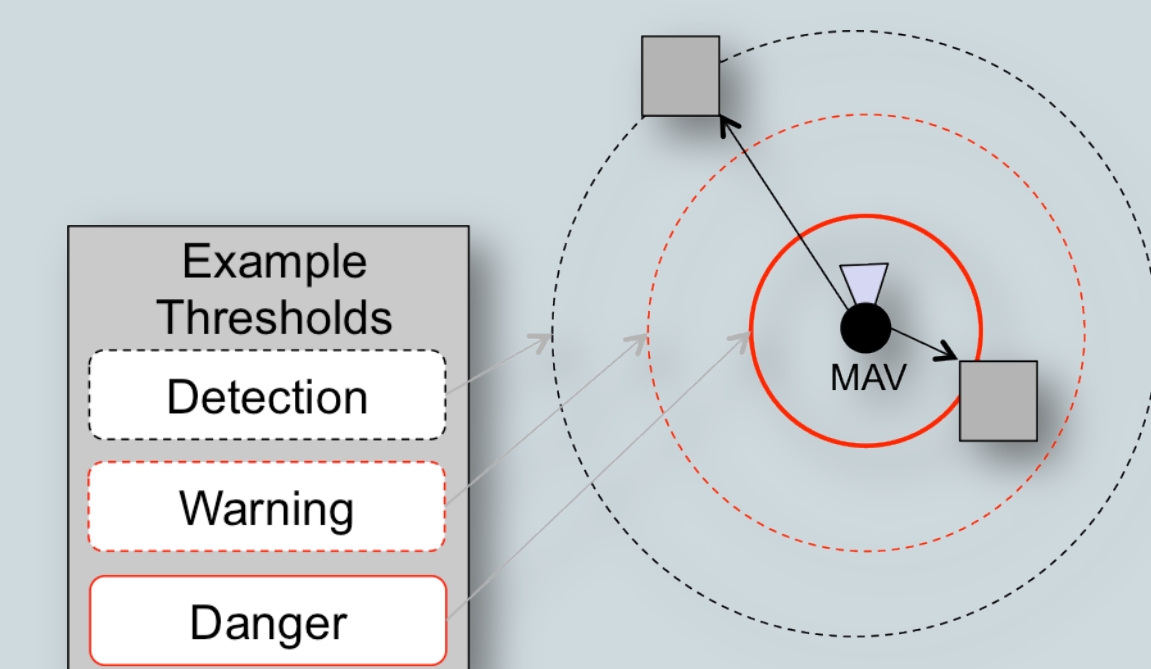
Alerting structure with three thresholds, corresponding to distance from the vehicle. Alert increases in distinct steps, rather than gradually
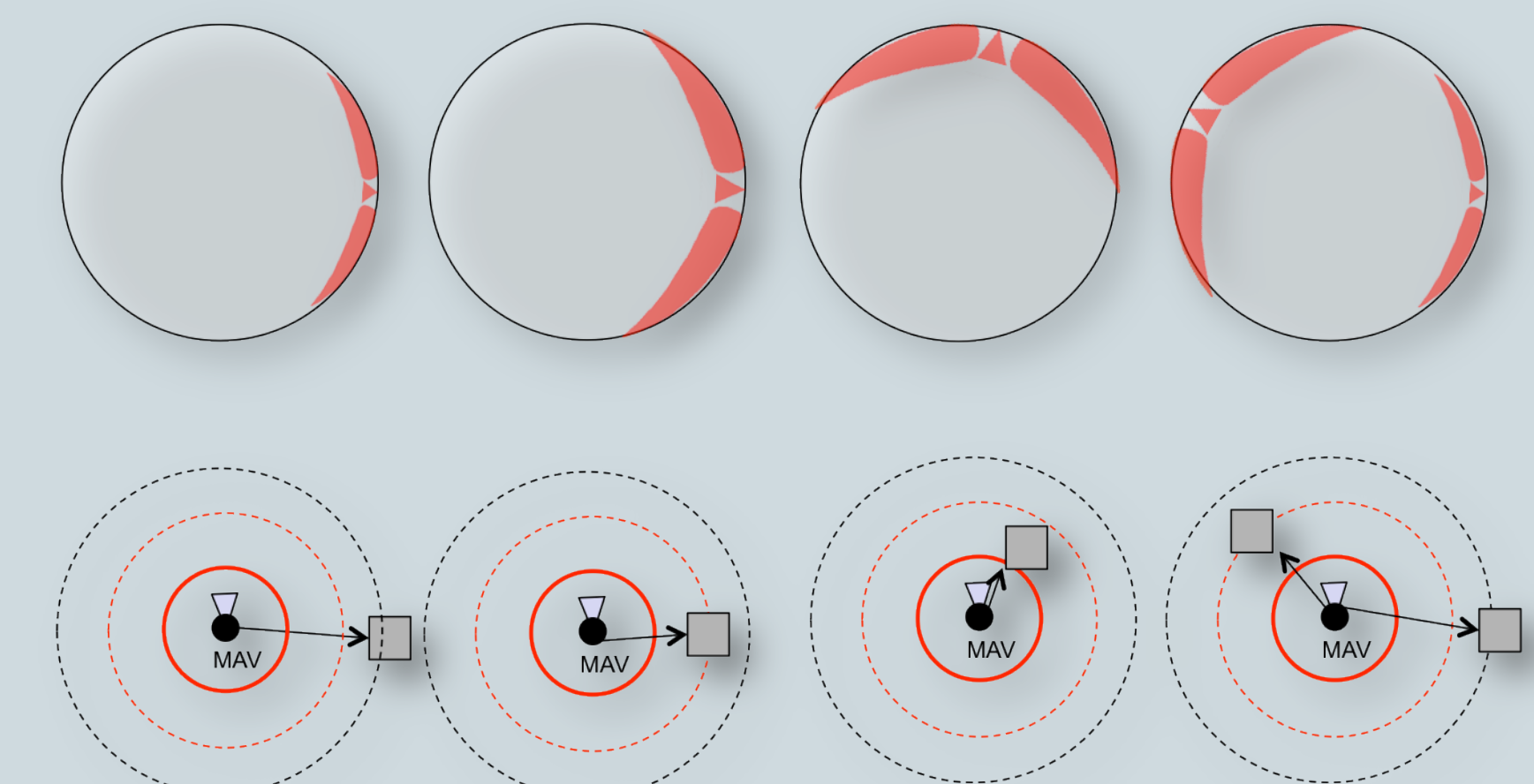


Examples of CODA display for various environmental conditions with the obstacle location (below) and resulting indicator (above)

References
1. K. Jackson. Development and Evaluation of a Collision Avoidance System for Supervisory Control of a Micro Aerial Vehicle. Masters Thesis, MIT, 2012.
2. D. Pitman. Collaborative micro-aerial vehicle exploration of outdoor environments. Masters Thesis, MIT, 2010.