2nd Annual Cal Poly Pomona Student Research Conference
March 7, 2014
University Library, Oral Presentations from 1 to 4 pm
Bronco Student Center (Ursa Minor), Poster Session and Reception from 4 to 6 pm

**Lead Author:** Blin Richards
**Degree objective when research was completed:** Bachelor's
**Major:** Aerospace Engineering
**College:** ENG

**Co-presenter(s):** Mathew Gan, John Dayton, Jordan Quintana, James Liu, and Miguel Enriquez

**Faculty Mentor(s):** Dr. Subodh Bhandari

**Session 10:** University Library - Special Collections Room
**Time of Presentation:** 3:15 PM

**Presentation Type:** Oral presentation

**Project Title:** Obstacle Avoidance System for UAVs Using Computer Vision

**Synopsis:** Our team has developed an obstacle avoidance system for fixed wing aircraft, by implementing optical flow and a stability augmentation system.

**Abstract:** Uninhabited Aerial Vehicles (UAVs) have the potential to replace inhabited aircraft for many civilian and military applications. They are cheaper and pose minimal risk to human pilots. However, the lack of obstacle avoidance capability has limited the use of these vehicles. The purpose of this research is to develop an obstacle avoidance system for use on small, fixed-wing UAVs. Computer based vision is used in conjunction with an automatic flight control system to detect and avoid obstacles in the UAV’s flight path. The computer vision will utilize video captured from two wing-mounted cameras. The frames of the video stream are inputted to the vision algorithm, where a hue saturation value filter developed from the OpenCV library, an open source library of computer vision algorithms, will separate objects from the background and determine which objects are of interest. Using a two-frame differential optical flow method, called the Lucas-Kanade method, pixel locations of objects of interest in a captured frame are compared to the same objects in the prior frame, thus creating a velocity vector and allowing future predictions of vectors to be made. The velocity vector values are outputted to the flight controller, which compares them to predetermined threshold values in order to make the correct avoidance decision. The flight controller is based on flight dynamics model developed using Athena Vortex Lattice (AVL) software. The AVL software uses aircraft’s aerodynamic, geometric, and mass properties and outputs the stability and control derivatives of the aircraft. The developed model is then used in hardware-in-the-loop (HIL) simulations for verification and gain tuning. Ground testing of the avoidance algorithms will then commence by moving objects in front of the UAV and observing the deflection of the surfaces to match those of the correct maneuvers of avoidance. The entire system will be flown in test flights.