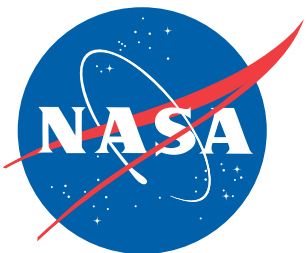


# Design and Development of an Autonomous Helicopter



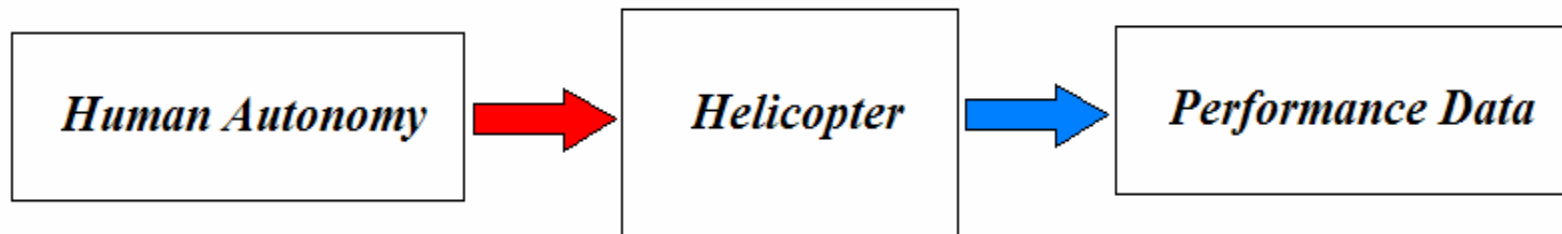
Jason King, NMSU Graduate Student  
October 20, 2006



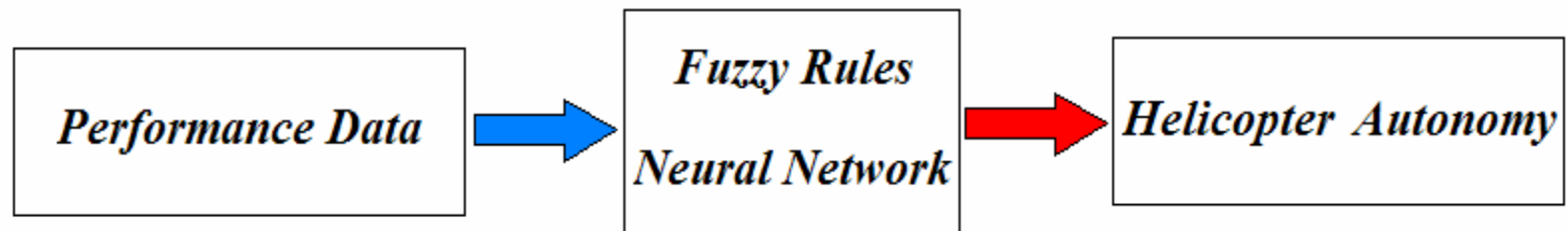
**Dr. Ram Prasad, RRL Director**

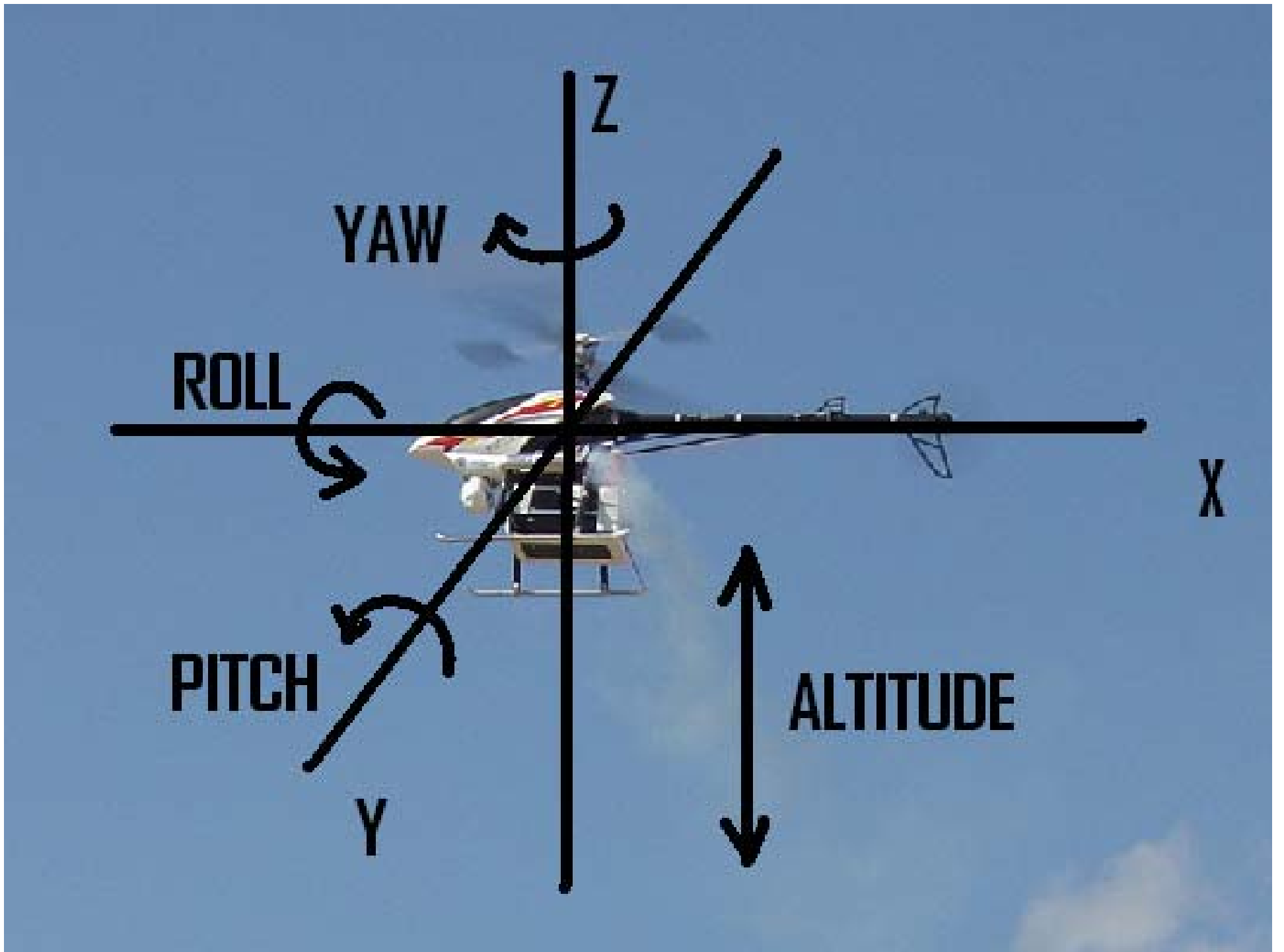
# Test & Analysis Objectives

## Testing



## Analysis

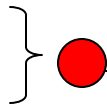




# ANFIS Architecture

## Inputs

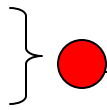
Roll Angle  
Roll Rate



## Outputs

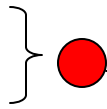
Output S1 } Roll Servo

Pitch Angle  
Pitch Rate



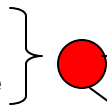
Output S2 } Pitch Servo

Yaw Angle  
Yaw Rate



Output S3 } Yaw Servo

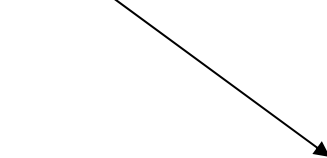
Altitude  
Altitude Rate



Output S4 }  
Throttle  
and  
Collective  
Servo



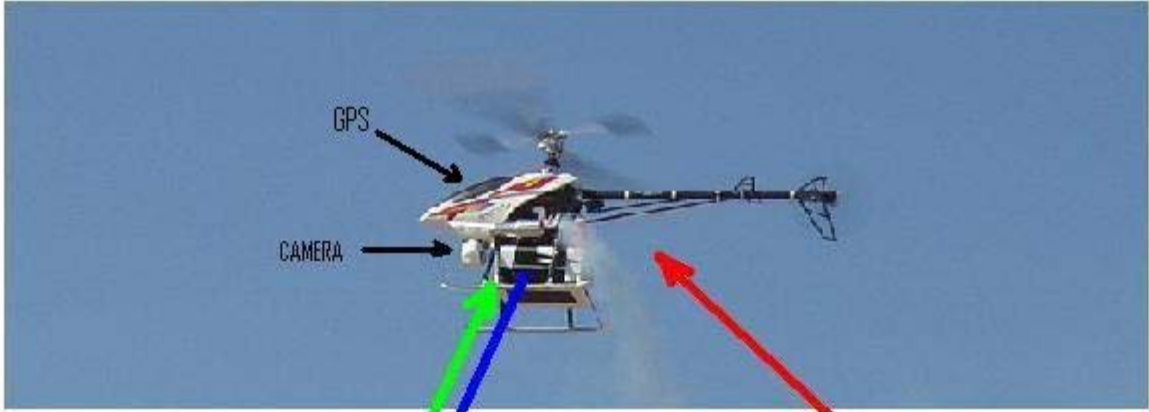
Output S5



# Rule Structure for Control

- If  $x_1$  is  $A_{j_1}$  and ... and  $x_n$  is  $A_{j_n}$ , then
$$u_j = f(x_1, x_2, \dots, x_n)$$
  - $x_i$  is the observed values of the input
  - $A_{ij}$  are fuzzy partitions
  - $f_j$  are functions
- Example:

If Yaw Angle is  $MF_i$  and Yaw Rate is  $MF_j$ , then the output is  $f(\text{Yaw Angle}, \text{Yaw Rate})$
- Fuzzy rules for each ANFIS channel are structured similarly

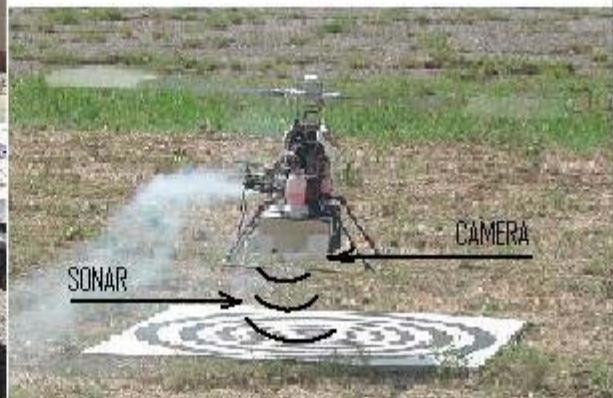


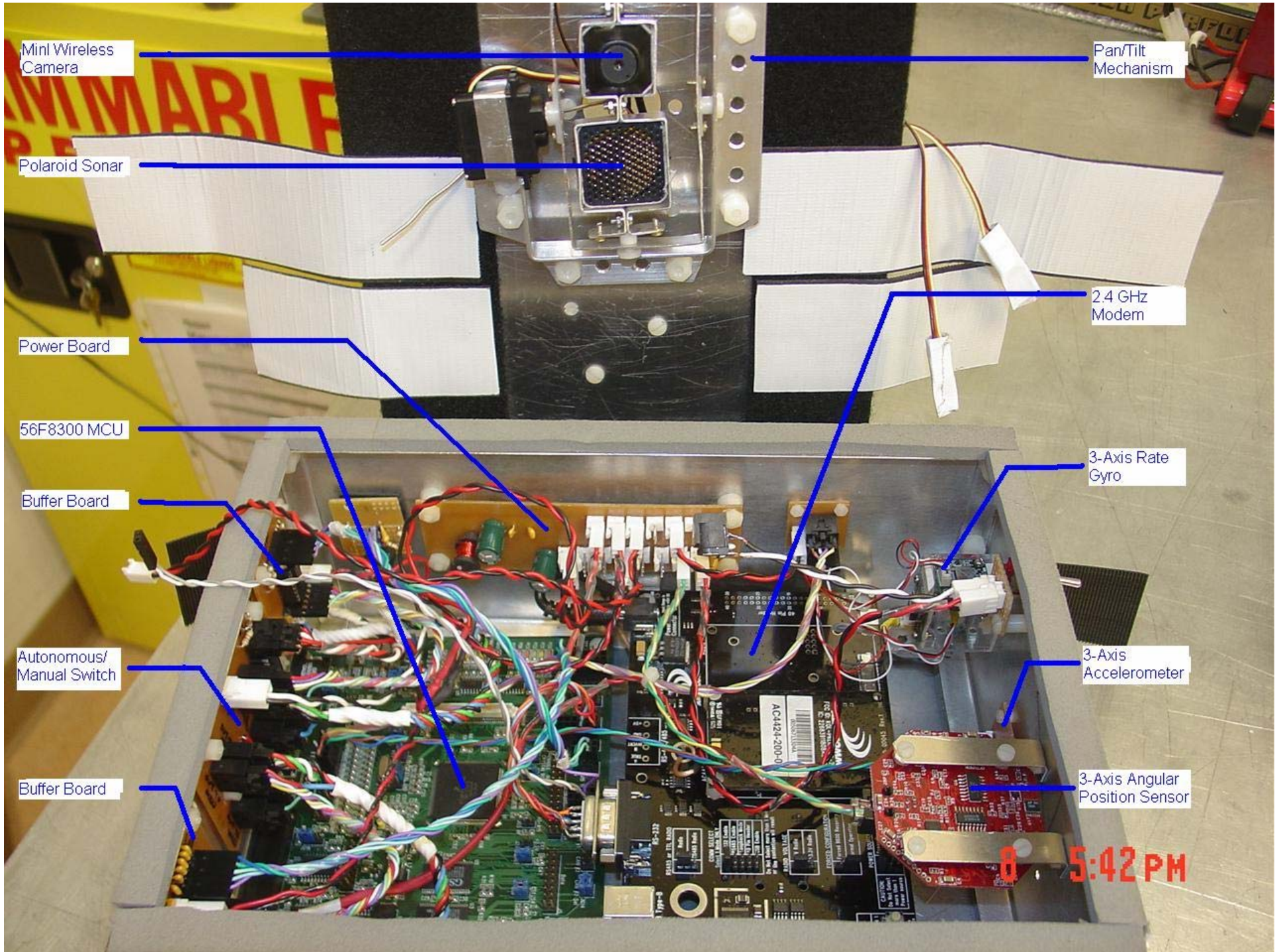
\* CONTROL COMMANDS UPLINKED

SENSOR DATA DOWNLINKED

RC TRANSMITTER

\* Still being developed





Mini Wireless Camera

Pan/Tilt Mechanism

Polaroid Sonar

2.4 GHz Modem

Power Board

56F8300 MCU

3-Axis Rate Gyro

Buffer Board

3-Axis Accelerometer

Autonomous/Manual Switch

3-Axis Angular Position Sensor

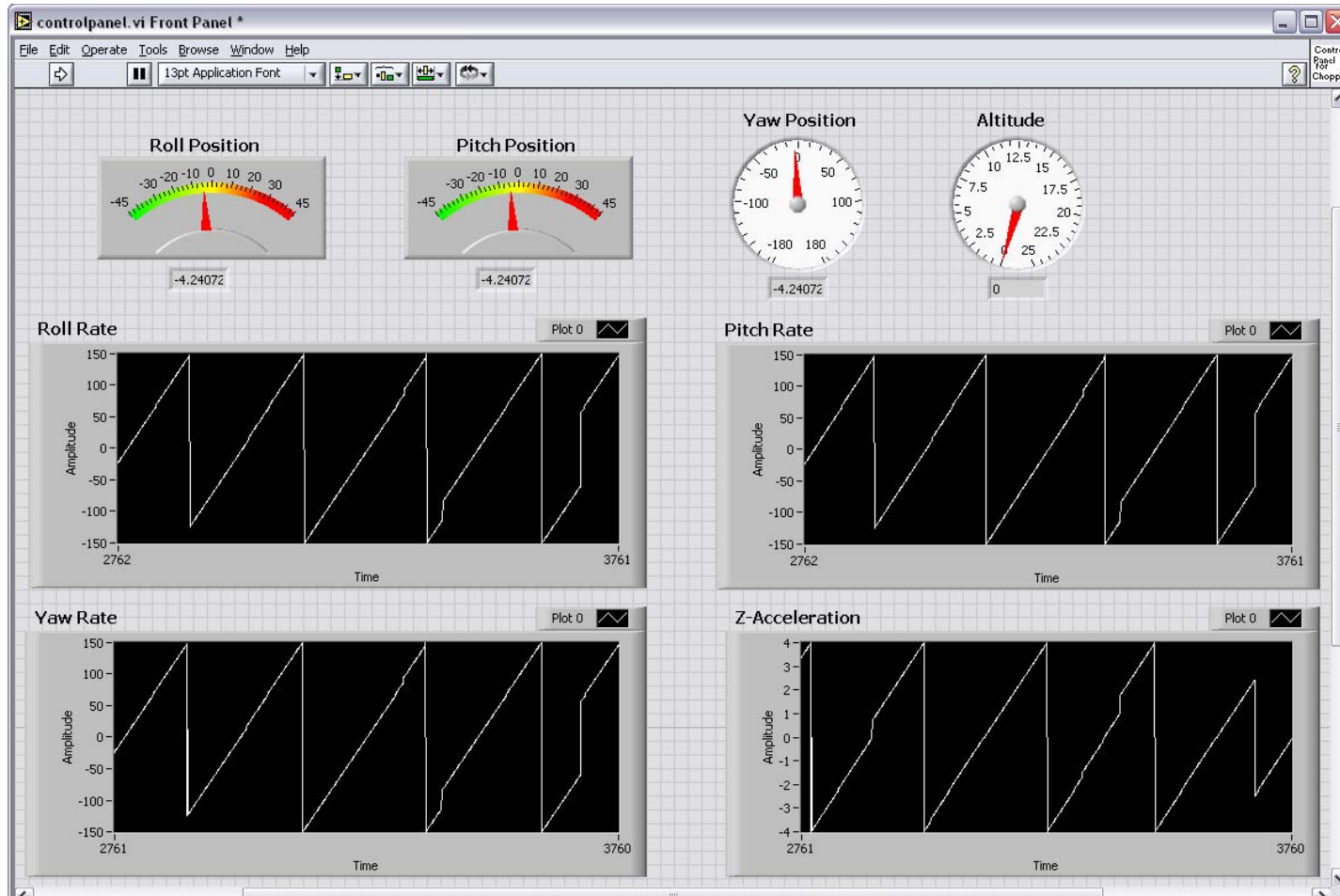
Buffer Board

8:54:22 PM



3 5:14 PM

# LabView Control Panel Ex.





altitude of the helicopter

Radio Frequency ID (RFID) system is used. This module transmits data from the helicopter to the ground station.

The data acquired by the sensors is collected by the MCU and transferred via the RF Module of the sensor box to the receiving RF Module of the Ground Station.

The Adaptive Neuro-Fuzzy Inference System (ANFIS) Matlab tool uses the saved data to create a mathematical model which simulates flight pattern. These models are used to train for autonomous flight.

Ground Station

The Ground Station uses Labview software to view and translate the received data stream into a user friendly graphical interface.

Future Development

Develop code for autonomous navigation.

8 5:22 PM



Special Thanks to  
Dr. Nadipuram Prasad &  
New Mexico Space Grant Consortium

