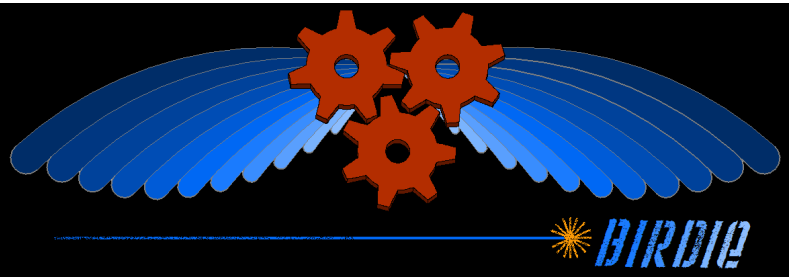


BIRDIE:

Biologically-Inspired low Reynolds number Dynamic Imagery Experiment

Interim Review 1

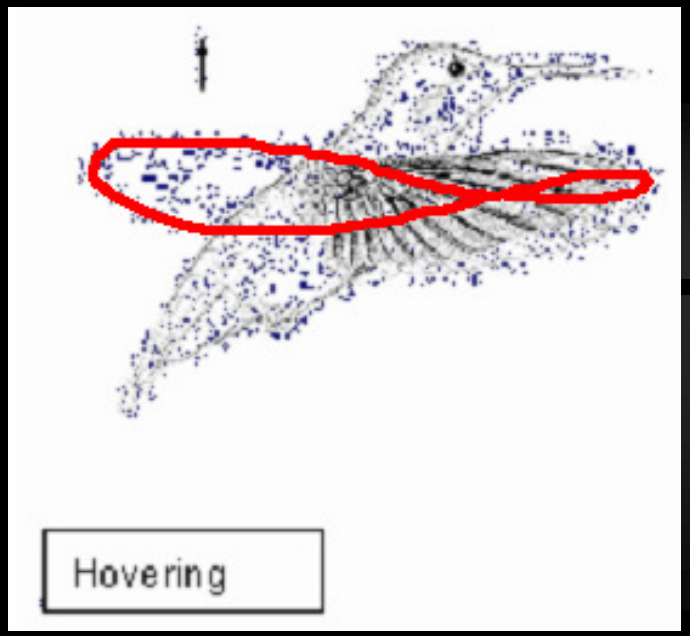
Jeff Baxter
Jeff Silverthorn
Matt Snelling
Courtney Terrell
Blake Vanier
Keith Wayman

2/26/2007

Overview

- ✓ Project Objectives Review
- ✓ Initial Design
- ✓ Issues from CDR
- ✓ Major Design Changes
- ✓ Current Design Summary
- ✓ Current Issues
- ✓ Test Plan
- ✓ Schedule/Budget Progress

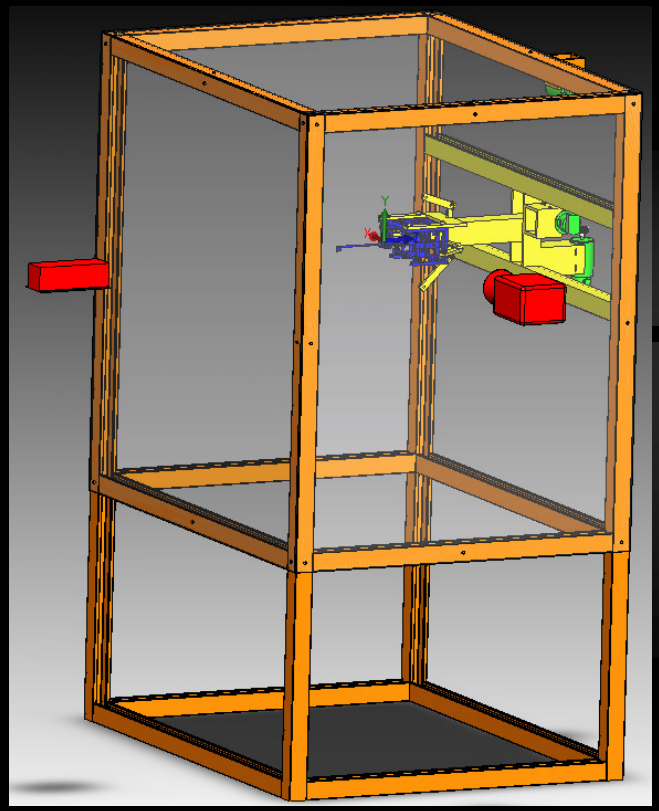
Project Objectives Review

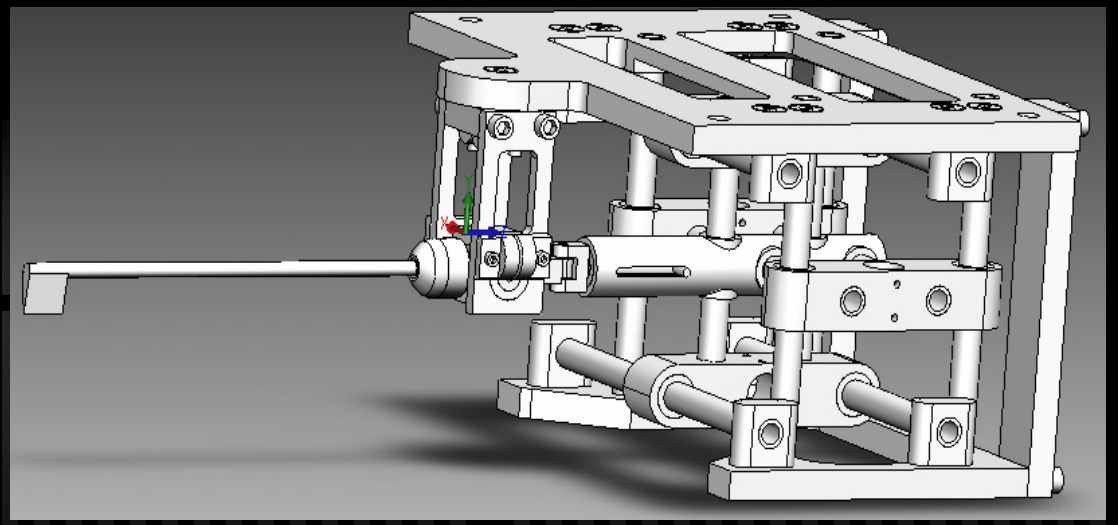


http://www.ae.utexas.edu/design/humm_mav/

- ✓ To create an experimental apparatus that can trace out a given wing motion similar to a hummingbird in hovering flight
- ✓ Design a system to capture the aerodynamic structures created by this wing motion

Initial Design





- Wing Mechanism
- Test Structure
- Visualization
- Support Structure
- Servos

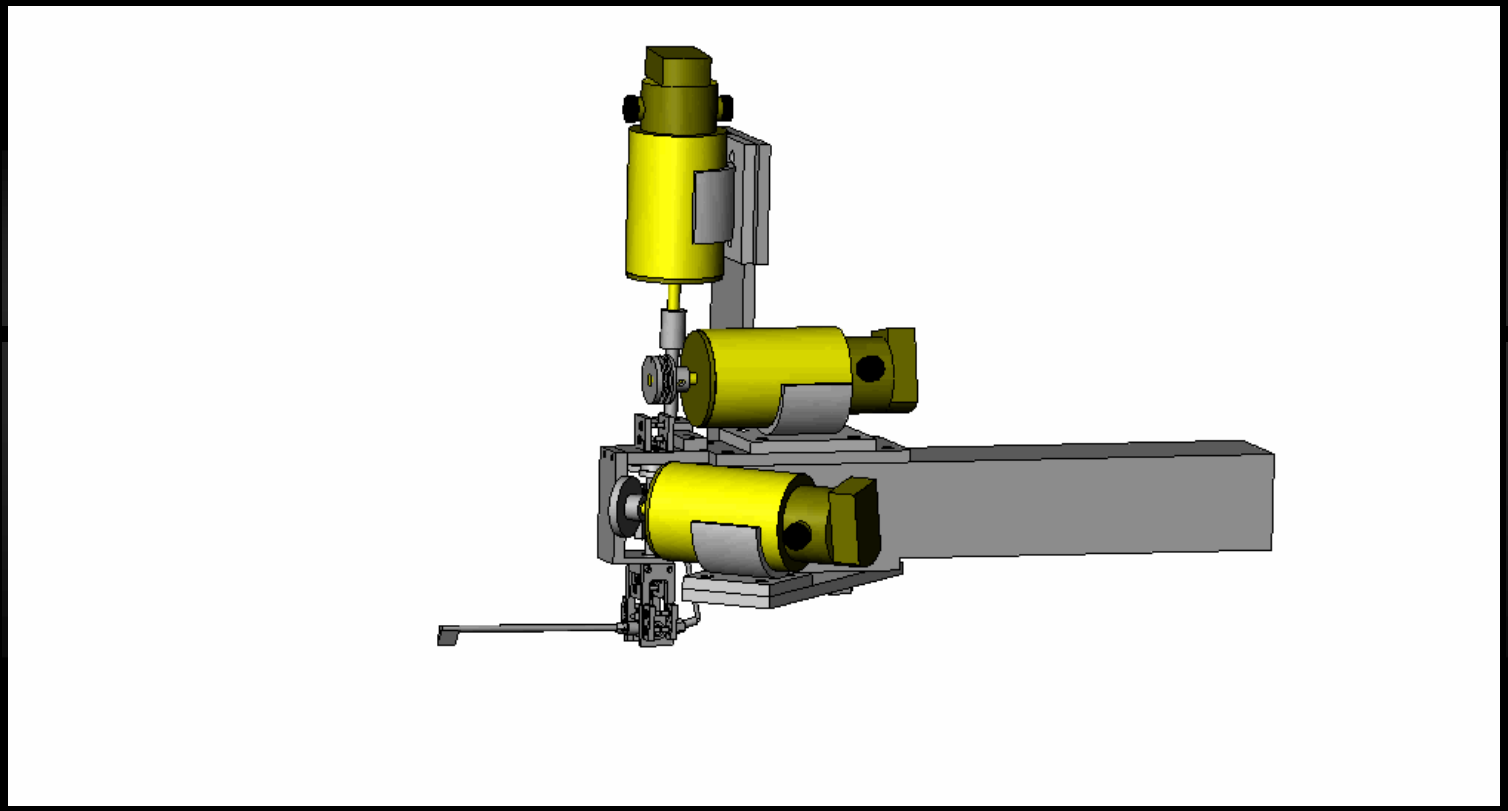
Issues from CDR

- No Official RFAs Issued
- PAB Concerns
  - Mechanical Complexity
  - Controllability and Vibrations
  - Friction and Wear

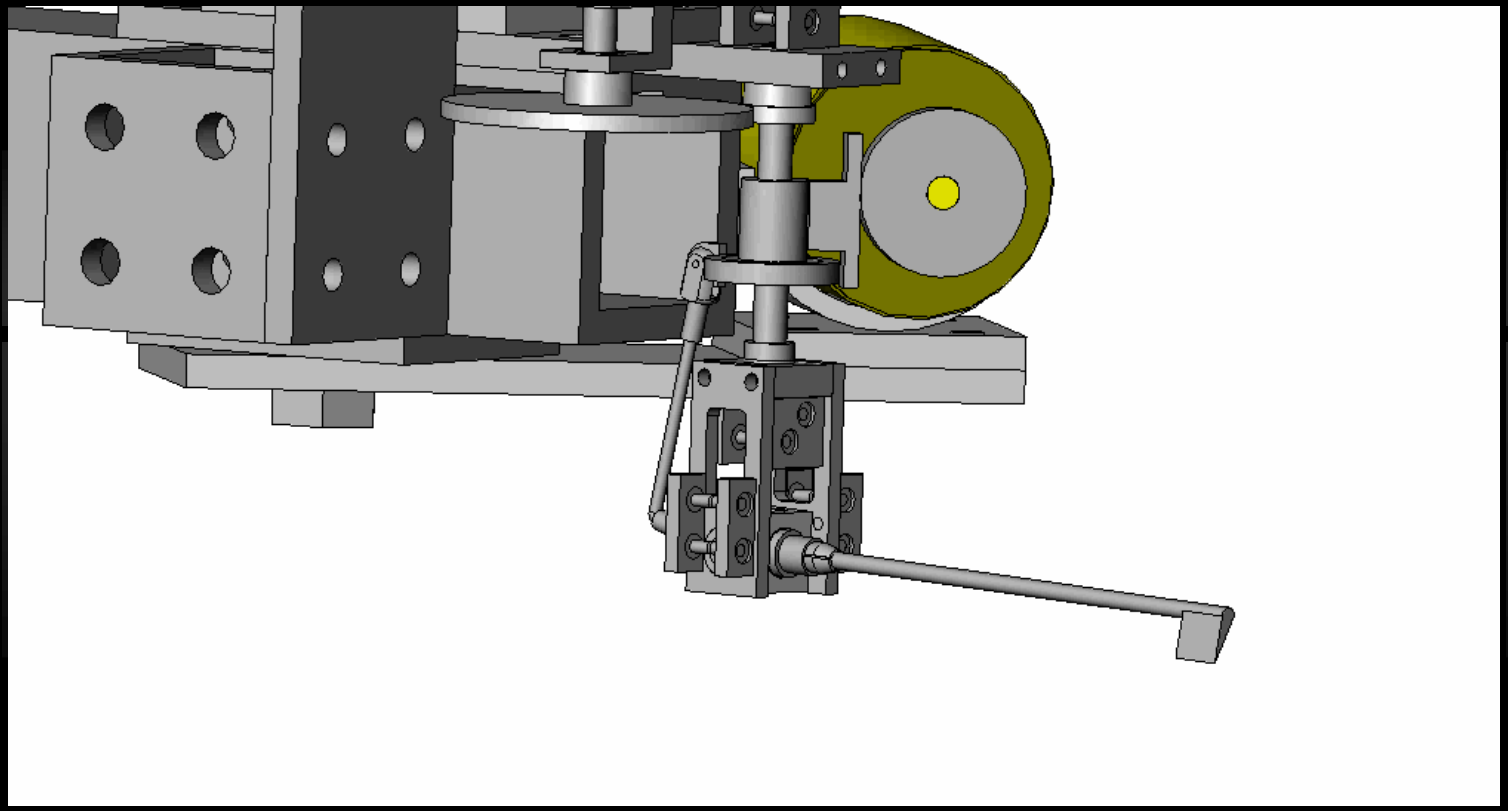
Major Design Changes

- Wing Mechanism Redesign
  - Mechanical Complexity
    - Reduced number of parts
  - Controllability and Vibrations
    - Motors positioned closer to wing mechanism
    - Direct gearing of two axes
  - Friction and Wear
    - Linear and rotary bearings used

Current Design Summary



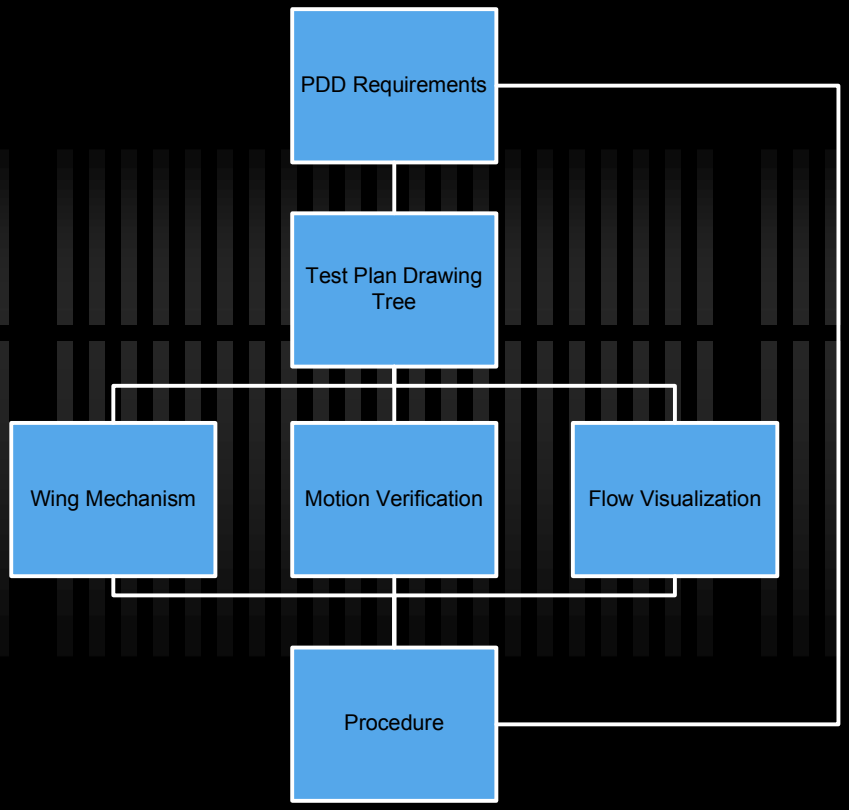
Wing Mechanism Movement



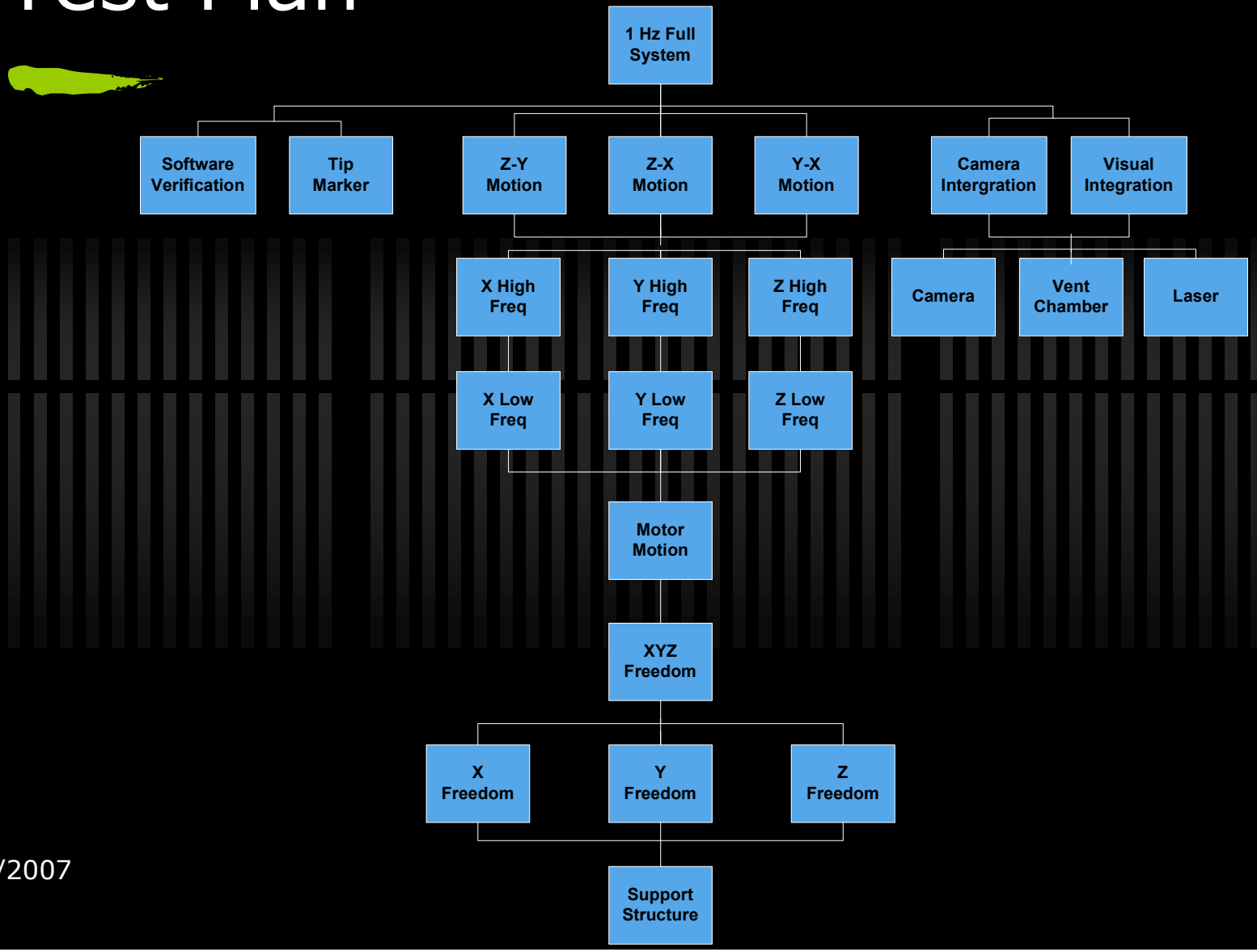
Current Issues

- Positioning of Motors
  - Lack fine adjustment
    - Capability will be added if time permits
- Smoke Delivery
  - Prototype testing confirmed basic feasibility of design
  - Spacing and length of flow jets are dependent on the new humidifier

Test Plan: Overview



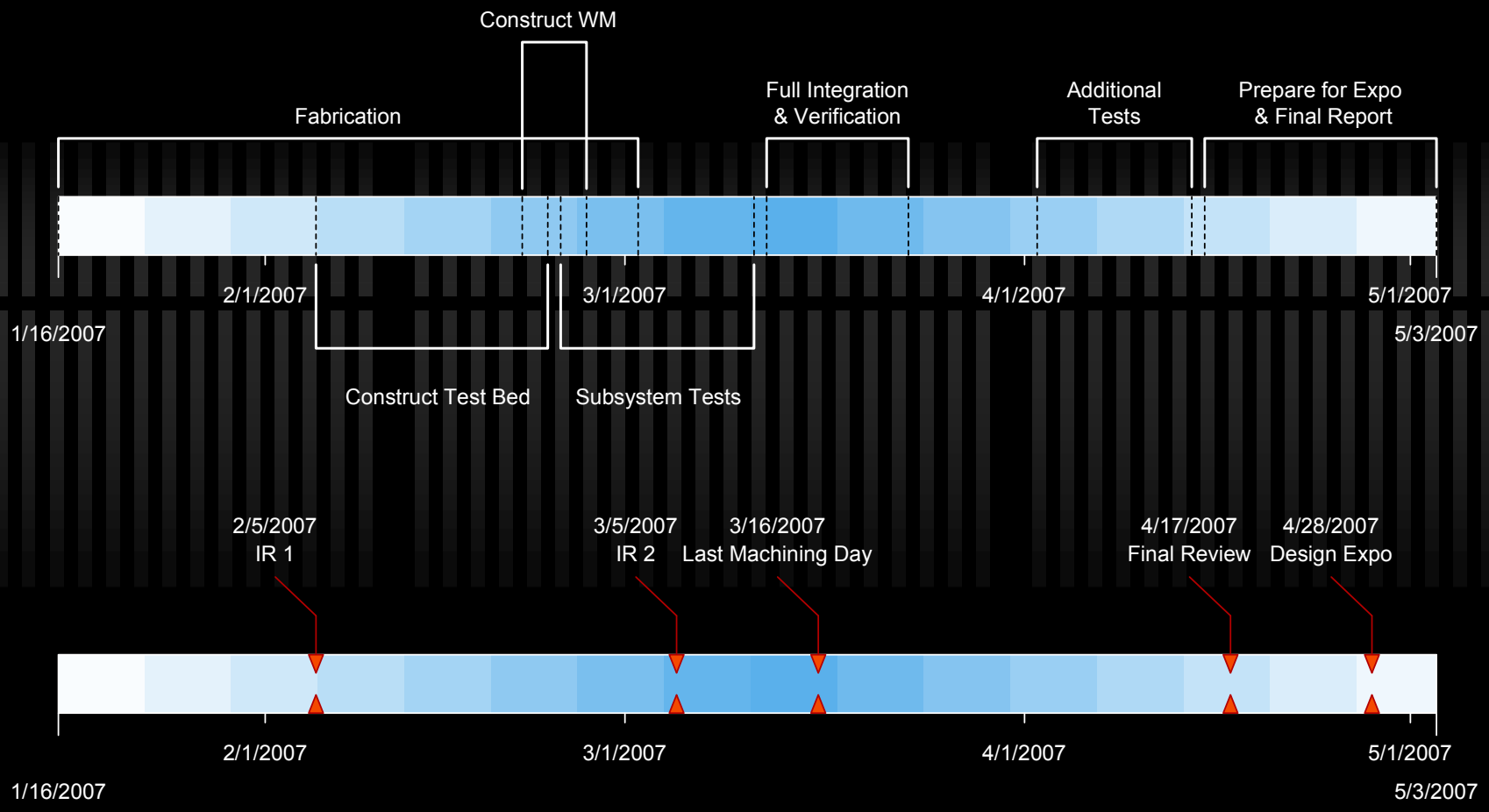
Test Plan


1 Hz Full System
Software Verification
Tip Marker
Z-Y Motion
Z-X Motion
Y-X Motion
Camera Intergration
Visual Integration
X High Freq
Y High Freq
Z High Freq
Camera
Vent Chamber
Laser
X Low Freq
Y Low Freq
Z Low Freq
Motor Motion
XYZ Freedom
X Freedom
Y Freedom
Z Freedom
Support Structure

Critical Tests

- Wing Motion Verification
  - Phosphorescent paint and IDL software
  - Deliverables: Position vs time and frequency
- Flow Visualization
  - Phantom camera and software
  - Deliverables: Confirm aerodynamic structure creation and visualization

Schedule Progress



Fabrication Progress

Purchased	32
Completed	1
Started	10
Haven’t Started	13

48% reduction in parts from initial design

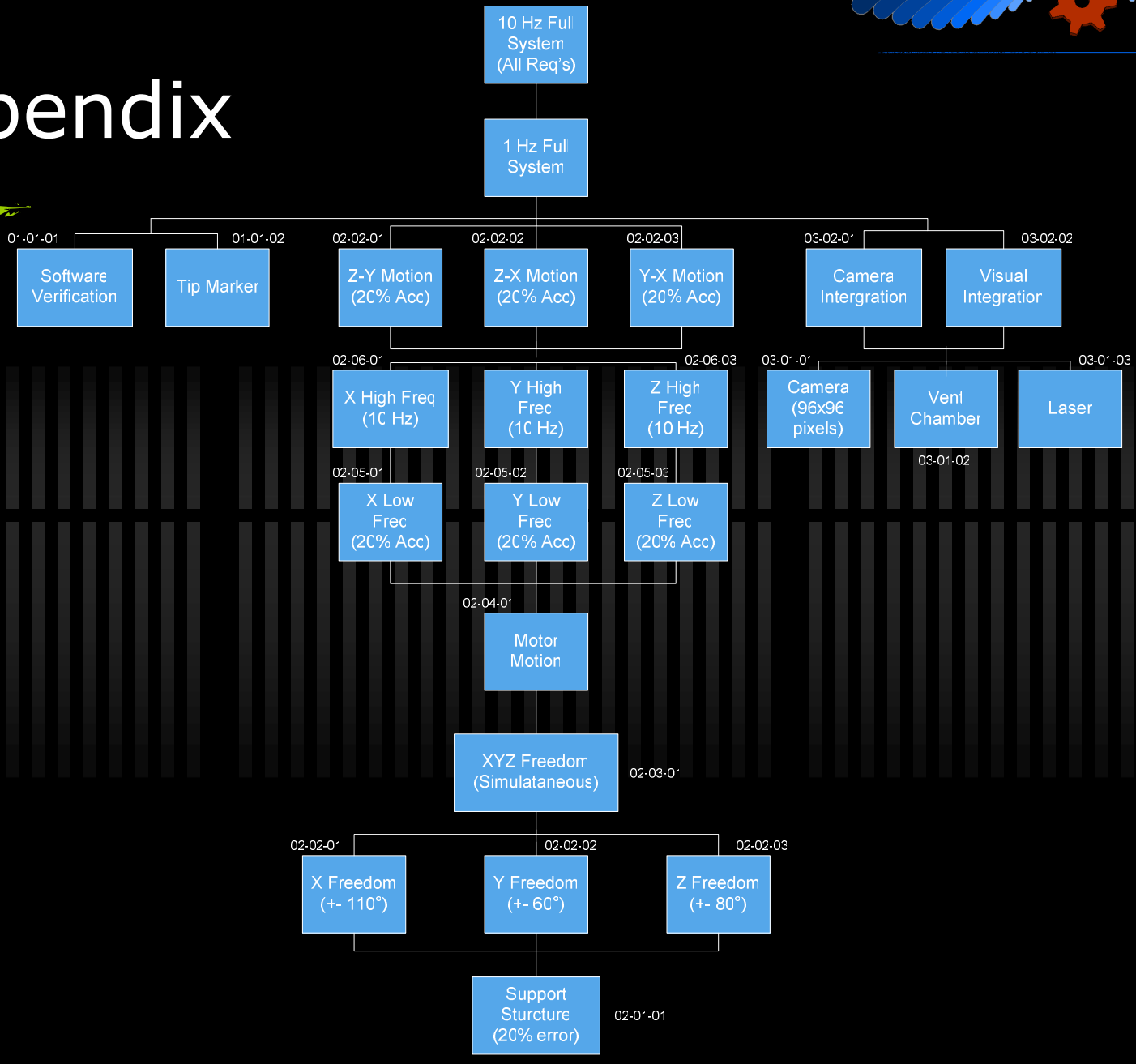
Budget Progress

Items		Company	Amount	Purchased
Electronics				
	Motors	Galil	$688.59	YES
	Amplifier	Galil	$595.00	YES
	Controller	Galil	$1,245.00	YES
	Cables	Misc	$80.00	YES
Software				
	Servo Design Kit	Galil	$195.00	NO
Test Bed				
	Polycarbonate	Bodeker	$250.00	YES
	Support Structure	Online Metals	$30.58	YES
Mechanism				
	Parts	Multiple	$313.56	YES
Visualization				
	Laser	Mohseni	$1,500.00	YES
	Wing Tip Paint	TBD	$12.99	NO
	Hard Drive	New Egg	$215.99	YES
	Safety Glasses	TBD	$400.00	NO
	Humidifier	TBD	$100.00	NO
Miscellaneous				
	Printing	Kinko's	$300.00	Fall-Yes, Spring-No

Total Spent	**$5,068.72**
Total Expected	**$5,926.71**
Total Budget	**$7,000.00** (with UROP and EEF)
Total Remaining	**$1,073.29**

Questions?

Appendix


10 Hz Full System (All Req's)
1 Hz Full System
0?-0?-01
Software Verification
01-0?-02
Tip Marker
02-02-0?
Z-Y Motion (20% Acc)
02-02-02
Z-X Motion (20% Acc)
02-02-03
Y-X Motion (20% Acc)
03-02-0?
Camera Intergration
03-02-02
Visual Integratior
02-06-0?
X High Freq (10 Hz)
02-06-03
Y High Frec (10 Hz)
Z High Frec (10 Hz)
03-01-0?
Camera (96x96 pixels)
Vent Chamber
03-01-02
03-0?-03
Laser
02-05-0?
X Low Frec (20% Acc)
02-05-02
Y Low Frec (20% Acc)
02-05-03
Z Low Frec (20% Acc)
02-04-0?
Motor Motion
XYZ Freedom (Simulataneous)
02-03-0?
02-02-0?
X Freedom (+- 110°)
02-02-02
Y Freedom (+- 60°)
02-02-03
Z Freedom (+- 80°)
Support Sturcture (20% error)
02-0?-01

Test Plan Drawing Tree

Test Number	Test Name	Purpose	PDD Requirement
01-00-00	Wing Motion Verification		
01-01-01	Verification Software	To ensure software calculates pixel positions correctly	Camera Visualization
01-01-02	Tip Marker	To track actual tip motion of the wing	Tip Illumination
02-00-00	Wing Mechanism		
02-01-01	Unistrut Structure	To ensure the Unistrut structure works	20% accuracy
02-02-01	Wing Mechanism Degrees of Freedom	To ensure wing degrees of freedom can be achieved separately	X=110°,Y=60°,Z=80°
02-03-01	XYZ freedom	To ensure all displacements and angles can be achieved together	Simultaneous
02-04-01	Motor compatibility/speed	To ensure the motors and electronics are software compatible	Motion
02-04-02	Rack and Pinion	To ensure the rack and pinion can be controlled as desired	Y Motion
02-05-01	Low Frequency Degrees of Freedom	To ensure wing degrees of freedom can be achieved separately at 0.25 Hz	20% accuracy
02-06-01	High Frequency Degrees of Freedom	To ensure wing degrees of freedom can be achieved separately at 10 Hz	10 Hz
02-07-01	XYZ motion low frequency	To ensure two and three axis motions can be achieved simultaneously at 0.25 Hz	Simultaneous
02-08-01	XYZ Motion High Frequency	To ensure two and three axis motions can be achieved simultaneously at 10 Hz	10 Hz Simultaneous
03-00-00	Flow Visualization		
03-01-01	High Speed Camera	To ensure that camera is available for integration and test	96x96 Pixels at 200 fps
03-01-02	Humidifier and Distribution	To ensure that the humidifier and distribution system works as expected	Illumination
03-01-03	Laser	To ensure that the laser works as expected	Illumination
03-02-01	Camera Integration	To ensure the camera integrates with the entire subsystem	Visualization
03-02-02	Visualization Integration	To ensure every component of the visualization subsystem integrates	Visualization