

University of Wyoming: Robo-Ops Team

Joshua Bailey

Thomas Bilodeau

Kyle Cox

Carter Schultz – Project Lead



Competition Overview



(University of Akron, 2010)

- NASA sponsored
- Sample retrieval
- 45 kg & 1m x 1m x .5m
- JSC rockyard

Determining Critical Functionalities

- Review of previous competitors
 - Competition footage
 - Technical papers
 - Competition results
- Analysis of competition regulations
- Risk centric analysis of proposed systems

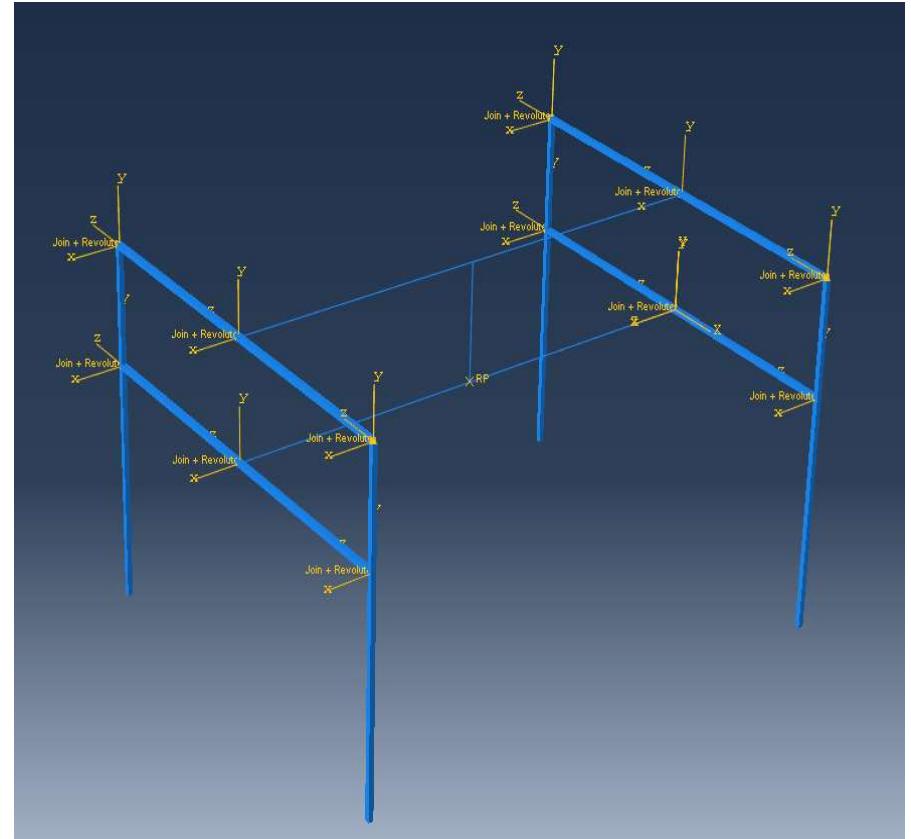
Design Overview

- Dual semi-identical rovers
- “Shrimp” suspension
- Modified commercially manufactured arm
- 3+1 DOF arm
- Simple and robust chassis
- Wheel hub motors

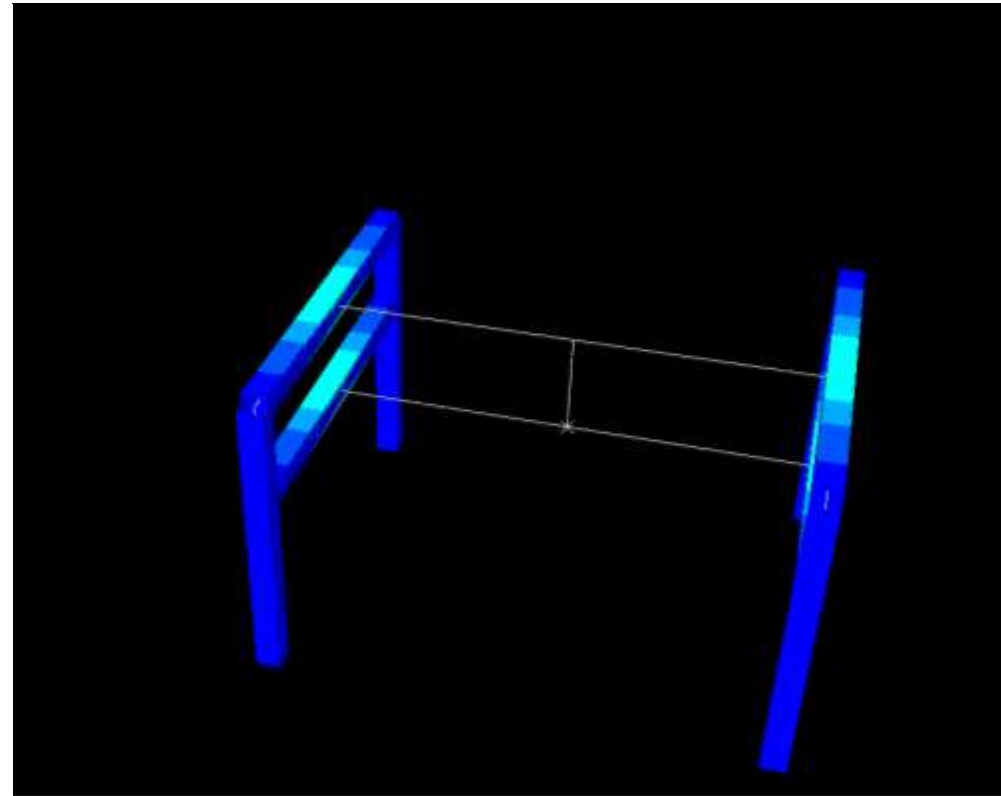
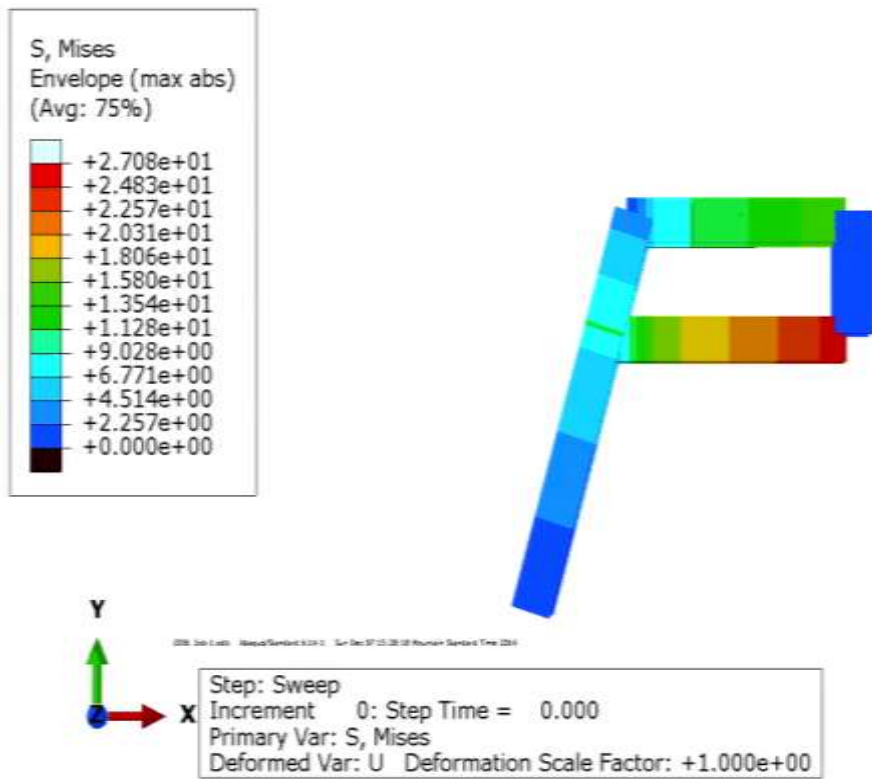


FEA Model Overview

- Non-linear geometry
- Truss elements
- Model combination
- Spring modeled



FEA Simulations



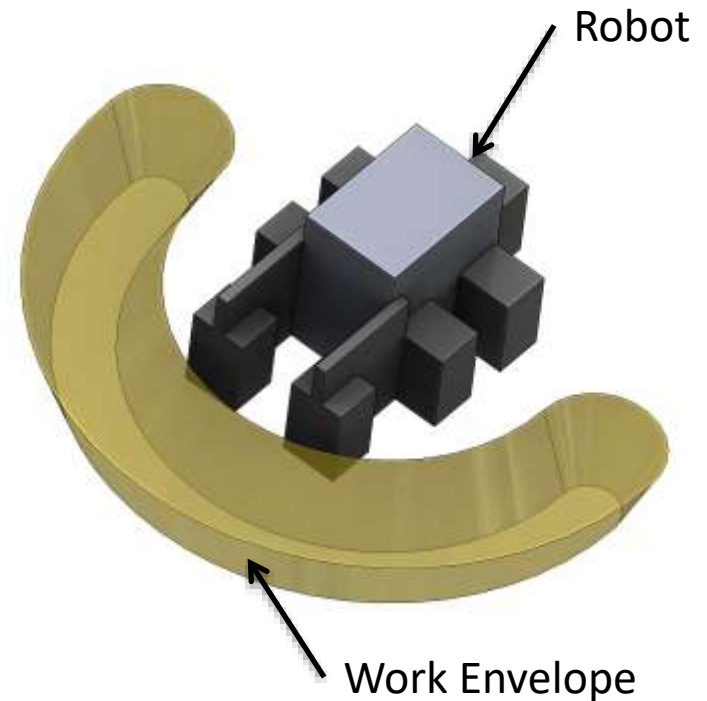
Chassis

- Simple yet functional design
- Weight and size constraints
- Ease of access to electrical components

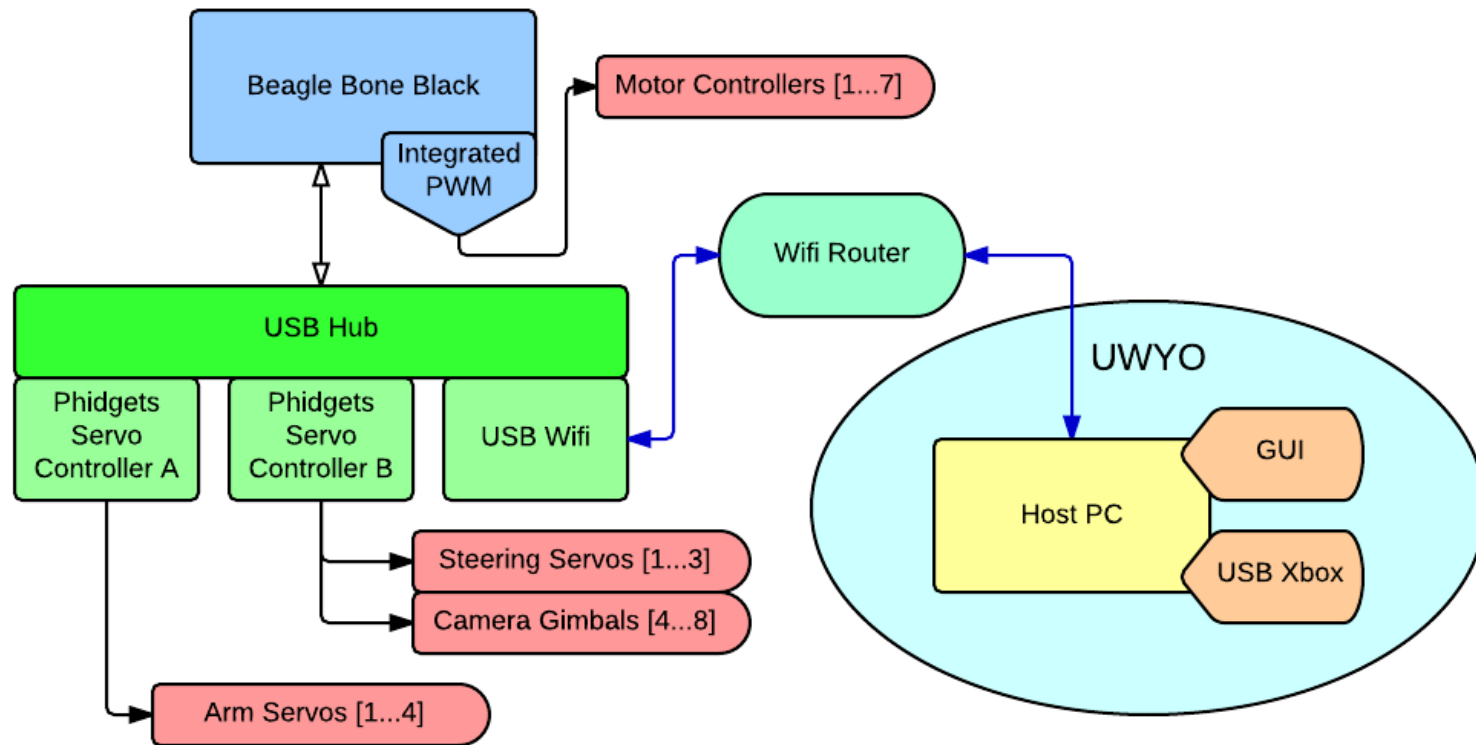


Resulting Manipulator Design

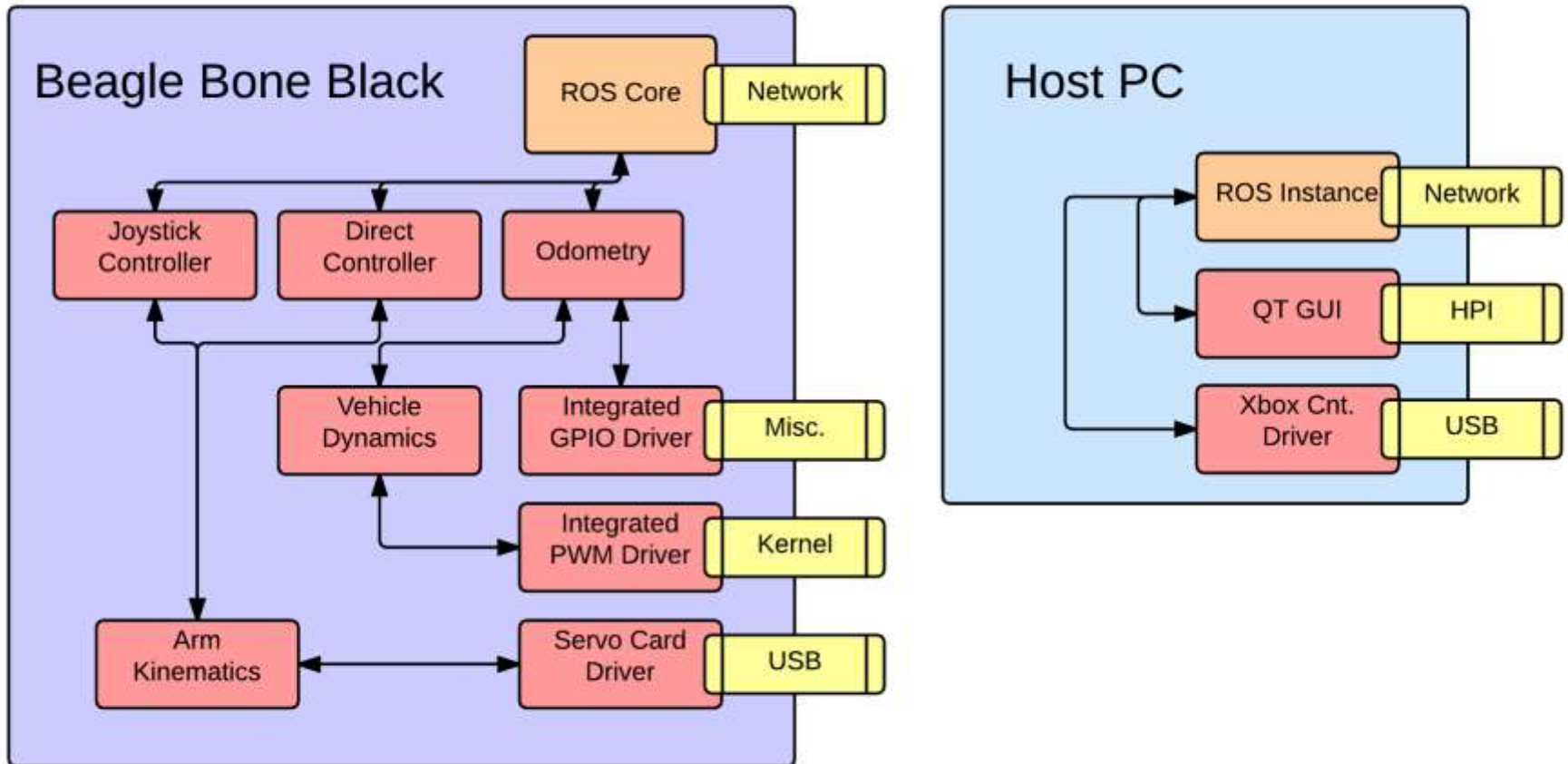
- Modified commercially available 4 DOF arm
- Changed to 3+1 DOF
- Optimized link lengths



Control System Overview



Software Overview



FMEA Analysis

Item	Potential Failure Mode	Potential Failure Effect(s)	Potential Causes of Failure	Current Prevention	Current Detection	Failure Likelihood	Severity of Consequences	Detection Likelihood	Risk Priority Number
Hub	Setscrew loosens	Inability to Drive	Damaged setscrew	Locktight	Visual	10	8	1	80
Steering Servo	Burnout	Inability to Steer	Overcurrent	Electric	None	2	8	3	48
Beagle Bone	Misc.	Complete failure	Misc.	None	None	4	9	1	36
Wheel	Fatigue	Inability to Drive	Overloading	None	Visual	3	8	1	24
Wheel Motor	Burnout	Inability to Retrieve	Overcurrent	None	None	2	3	4	24
Steering Servo Linkage	Setscrew loosens	Inability to Steer	Vibration	None	Visual	5	4	1	20
Suspension Shaft	Shear	Inability to Drive	Overloading	None	Visual	2	8	1	16
Arm Servo	Burnout	Inability to Retrieve	Overcurrent	Electric	None	2	8	1	16
Arm Structure	Misc.	Inability to Retrieve	Overloading	None	Visual	2	8	1	16
Fork Travel Stop	Disconnection	Reduced Drive Capability	Vibration	Velcro	Visual	4	4	1	16
Motor Controller	Burnout	Inability to Drive	Overcurrent	Electric	Visual	2	8	1	16
Servo Controller	Burnout	Inability to Drive	Overcurrent	Electric	Visual	2	8	1	16
Battery	Internal Short	Complete failure	Damaged	None	None	1	10	1	10
Chassis	Misc.	Complete failure	Overloading	None	Visual	1	8	1	8

Critical Components

- Wheel Hubs
- Beagle Bone
- Steering Servos



Verification

Attribute Name	Target Value	Achieved Value	Percent Difference
Mass	17.0 Kg	12.3 Kg	-26.7 %
Top Speed	5 MPH	5.2 MPH	+0.4 %
Arm Payload	150 g	317 g	+111.3 %
Budget	\$3,000	\$2,332.85	-22.2 %

- Completed the scope of the project

What Next?

- Transition to next years team
- Inclusion of additional sensors
- Redundant communications control
- Redesign of existing issues:
 - Wheel Hubs
 - Front Forks
- Construction of second rover

References

- (University of Akron) "Honors Student, Courtney Gras, Receives Multiple Awards/Honors." *Http://www.uakron.edu/*. 1 Jan. 2010. Web.
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Questions?