

Engineering Student Technology Committee

<http://www.engr.colostate.edu/ESTC>

College of Engineering

Colorado State University

1. Title of Proposal: Mechatronics Laboratory Upgrades

2. Proposal Participants:

Primary Contact for Proposal

Name: Luke Walker E-Mail: lgwalker@colostate.edu

Department/Major: Mechanical Engineering

Check One: Faculty Staff Student

Additional proposal participants

Name: Steve Johnson E-Mail: steve.johnson@colostate.edu

Department/Major: Mechanical Engineering

Check One: Faculty Staff Student

Name: Tammy Donahue E-Mail: tammy.donahue@colostate.edu

Department/Major: Mechanical Engineering

Check One: Faculty Staff Student

Name: Sue James E-Mail: susan.james@colostate.edu

Department/Major: Mechanical Engineering

Check One: Faculty Staff Student

Name: Ben Gadomski E-Mail: ben.gadomski@colostate.edu

Department/Major: Mechanical Engineering

Check One: Faculty Staff Student

3. Proposal Abstract (limit to 100 words):

The mechatronics laboratory bridges the gap between electrical and mechanical engineering. The lab equipment has remained static for over a decade and desperately needs upgrades to provide the necessary tools to our students for later research and industry skills. We are offering a proposal for \$47,604.50 in ESTC funds, matching \$55,205.50 in departmental funds to upgrade technology and provide additional working stations to properly meet the course

learning objectives. Upgrades will be administered by mechanical engineering lab support to stretch resources further, and updates will be provided to the ESTC board during the upgrade to ensure objectives are being met.

4. Proposal Budget

List of items to purchase and cost of each

Mechatronics Laboratory Upgrades							
Scientific Equipment				Cost Sharing			
Item	Price	Quantity	Subtotal	ESTC %	Department %	ESTC \$	Department \$
NI Elvis II+	\$2,335.50	10	\$23,355.00	50%	50%	\$11,677.50	\$11,677.50
Tektronix Digital Multimeter	\$879.00	10	\$8,790.00	50%	50%	\$4,395.00	\$4,395.00
Tektronix Power Supply	\$1,190.00	10	\$11,900.00	50%	50%	\$5,950.00	\$5,950.00
Tektronix Waveform Generator	\$1,880.00	10	\$18,800.00	50%	50%	\$9,400.00	\$9,400.00
Tektronix Oscilloscope	\$2,480.00	10	\$24,800.00	50%	50%	\$12,400.00	\$12,400.00
Arduino Kits	\$40.00	10	\$400.00	50%	50%	\$200.00	\$200.00
		Subtotal	\$88,045.00			\$44,022.50	\$44,022.50
Non Scientific Upgrades				Cost Sharing			
Item	Price	Quantity	Sub Total	ESTC %	Department %	ESTC \$	Department \$
Tables	\$583.00	8	\$4,664.00	0%	100%	\$0.00	\$4,664.00
Chairs	\$100.00	25	\$2,500.00	0%	100%	\$0.00	\$2,500.00
Computers	\$550.00	8	\$4,400.00	50%	50%	\$2,200.00	\$2,200.00
Monitors	\$200.00	16	\$3,200.00	50%	50%	\$1,600.00	\$1,600.00
		Subtotal	\$14,764.00			\$3,800.00	\$10,964.00

						ESTC \$	Department \$
					Equipment	\$44,022.50	\$44,022.50
					Upgrades	\$3,800.00	\$10,964.00
					Total	\$47,822.50	\$54,986.50

Dollar or percentage amount requested from ESTC: \$47,822.50

5. Full description of proposal:

The Mechatronics course (MECH307) is a required junior year mechanical engineering course that bridges the disciplines of mechanical and electrical engineering. Prerequisites for the course are Dynamics (CIVE261), Introduction to Electrical Engineering (ECE204), Differential Equations (MATH340), and Engineering Experimentation (MECH231). Mechatronics is a prerequisite for Experimental Analysis (MECH402) which is a co-requisite for Senior Design (MECH486A/B).

The format of the course is classroom instruction on the function and utilizations of electromechanical components coupled with a lab where the classroom knowledge is applied in the format of building and testing circuits. The characteristics of these circuits are analyzed to determine the adherence to the predicted function and this knowledge is directly used in the course project which consists of an open assignment requiring a certain set of components and controls. Outside of the controls package the overall function of the final project is left completely up to the students. This lab project has traditionally been one of the most successful hands-on projects offered in the mechanical engineering program and a comprehensive list of past projects can be viewed at http://video_demos.colostate.edu/mechatronics/#PIC_PROJECTS

The technology used in this course provides a great understanding of the basics of microprocessors and electrical controls, but the lab instruments used in the course have essentially remained static for over a decade and are becoming seriously outdated. We have recently upgraded several teaching laboratories where National Instruments hardware has been implemented and interfaced with LabView software, our department has progressively invested ~\$80k across these labs over the last three years. The current mechatronics technology does now allow for this interface, and there are several tools readily available that would increase both the understanding and capabilities of our students. We have attached our overall budget for the complete lab upgrade and broken out the section where we are requesting \$47,822.50 in CFT funds through the ESTC to match departmental funds (\$54,986.50, a 50/50 split) for the Scientific Equipment part of the upgrade.

The component selections for the hardware have been based off of research, conversations with subject matter experts, and a visit to the University of Wyoming to see their mechatronics program. We would plan to use a very similar hardware format to UW, but would have some modifications to better connect the components to LabView. The Tektronix

components have the proper connectivity, and the ElvisII+ boards are NI hardware that we can easily integrate. The Arduino kits would be an experimental departure from the current PIC microcontrollers currently in use, and we would likely switch the actual Arduinos for a Texas Instruments controller that has very similar functionality but very few programs available online for download. This combination would allow students to measure circuit performance in real-time with much greater accuracy, leading to better functional understanding and increased ability to optimize.

As with all CSU programs, we have been absorbing an increasing number of students into our courses which has translated into larger lab groups in each section. Where we typically had 3-4 people per group in 2012, we now routinely have 5. This large of a group is a hindrance to hands-on learning and our proposal is in line with a goal of reducing the lab groups to 3 by expanding the number of stations from 6 to 10. The extra hardware available would also position us to make lab resources more available to cross-departmental projects and classes, as well. The purpose of the mechatronics concentration is to bridge the gap between mechanical and electrical engineering, this is the next natural step in the evolution to a better program.

As we upgrade our technology in this lab, the overall goal is to both create additional capabilities for our students as well as increase access to the lab and technology. The hands-on aspects of the CSU mechanical engineering program are what set us apart from other engineering programs, and a more capable mechatronics lab allows us to better teach electrical interfaces from the Introduction to Circuits course up through Senior Design. The strategic vision is to move toward creating a uniform data acquisition package across all of our labs (NI hardware and LabView software), as well as creating collaborative opportunities with other departments and programs to develop new electrical systems and components within the learning environment. The lab support engineering team will make themselves available to present this material and are happy to field any questions or concerns you may have as you consider this proposal.