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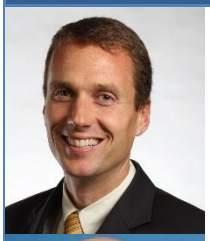
Computing & Systems Technology Division (CAST) Welcomes



John Hedengren and Abe Martin

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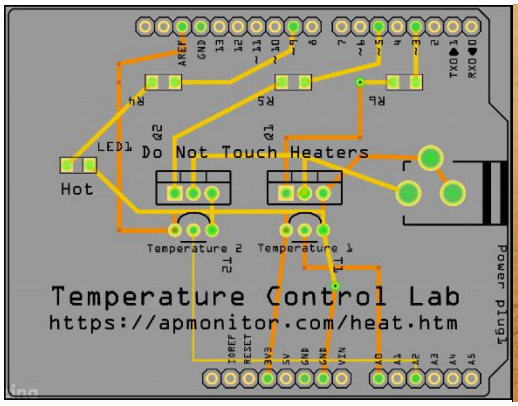
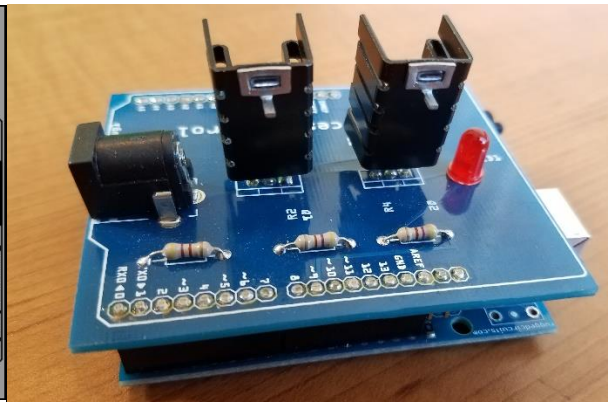
Pocket-Sized Heat Transfer Lab for Dynamics and Control

The 2015 NSF-sponsored report *Chemical Engineering Academia-Industry Alignment: Expectations about New Graduates*[1] identifies a strong industrial need for practical understanding of process control and system dynamics. Industry feedback also suggests more weight on translating process control theory to practice. To meet this need, laboratory experiences are integrated into many process control courses. With the growth of enrollment in chemical engineering, laboratory resources are often strained and scheduling for these labs can be difficult to manage. For this reason, we developed a pocket-sized process control lab to reinforce process control theory to give a lab to each student.





We give the small and inexpensive process control experiment to students to reinforce concepts in dynamics and control theory. We'll share our experience with implementing the Arduino-based temperature control lab for the process dynamics and control course. We'll also share a number of potential pitfalls that limit the learning potential of the lab experience. A few universities are currently testing this pre-built lab for adoption or modification. The objective of this session is to introduce the lab with associated software modules.

Software Modules

- Set heaters to generate a step response
- Estimate parameters to determine a model
- Tune a PID controller
- Reject disturbances and track setpoint
- Develop multivariate control methods
- Introduce advanced control topics such as Model Predictive Control (MPC)

This lab was presented at the 2017 ASEE Summer School at NCSU as part of resources for teaching process transient analysis. Lab solutions for instructors are provided in Python and MATLAB. See https://apmonitor.com/heat.htm for additional lab details.

To join the upcoming bulk order to be manufactured in China ($20/lab), fill out information here: **https://goo.gl/forms/1lLOOyMTEWONui6o2**

Lab source files and a parts list are also available.

Biography:

John Hedengren is a Chemical Engineer by training with a B.S. and M.S. degree from Brigham Young University and a Ph.D. from the University of Texas at Austin. He is an Associate Professor at Brigham Young University in the Chemical Engineering Department and leads the PRISM (Process Research and Intelligent Systems Modeling) group. Prior to BYU he worked as a consultant for companies on automation solutions and then full-time for 5 years with ExxonMobil supporting advanced control and optimization solutions. Dr. Hedengren's area of expertise is in fiber optic monitoring, unmanned aerial systems, automation of production and drilling, and development of new technologies that monitor and control upstream infrastructure.

R. Abraham (Abe) Martin is a Ph.D. candidate at Brigham Young University and developed the process control lab. His research focuses on the simultaneous design and control of High Altitude Long Endurance (HALE) aircraft. He recently completed a graduate internship at the Air Force Research Laboratory with a focus on computer vision and aerial vehicles. He previously completed a graduate internship at Idaho National Laboratory in modeling a hybrid nuclear energy system. He is a 3 Minute Thesis award recipient (see **https://youtu.be/KrB02LI5i4Q**) and a National Merit Scholar. He is currently in his 3rd year and planning to graduate in 2018.

Jeff Kantor received his B.S. in Chemical Engineering from the University of Minnesota and an M.A. and Ph.D. from Princeton University. He joined the University of Notre Dame in 1981. He was the Vice President & Associate Provost and then became the Vice President for Graduate Studies and Research at Notre Dame. He is currently a professor in the Department of Chemical

and Biomolecular Engineering. Dr. Kantor is interested in the analysis and optimization of integrated financial and process operations using methods of stochastic control, convex optimization, and quantitative finance.

References

[1] Luo, Y., Westmoreland, P.R., et. al., *Chemical Engineering Academia-Industry Alignment: Expectations about New Graduates*, An NSF-Sponsored Study led by the American Institute of Chemical Engineers, URL: **https://goo.gl/6uAbbe**

Join Webinar on Oct 10, 2017 at 11 AM Eastern Time (EDT) at http://goo.gl/5ySqO4