

Spring 4-2015

Fluids Dynamics & Heat Transfer Lab Design

Bruce Gerry
University of Southern Maine

Follow this and additional works at: https://digitalcommons.usm.maine.edu/thinking_matters

 Part of the [Engineering Science and Materials Commons](#)

Recommended Citation

Gerry, Bruce, "Fluids Dynamics & Heat Transfer Lab Design" (2015). *Thinking Matters Symposium Archive*. 36.
https://digitalcommons.usm.maine.edu/thinking_matters/36

This Poster Session is brought to you for free and open access by the Student Scholarship at USM Digital Commons. It has been accepted for inclusion in Thinking Matters Symposium Archive by an authorized administrator of USM Digital Commons. For more information, please contact jessica.c.hovey@maine.edu.

Fluids Dynamics & Heat Transfer Lab design

Bruce Gerry

University of Southern Maine, Department of Engineering

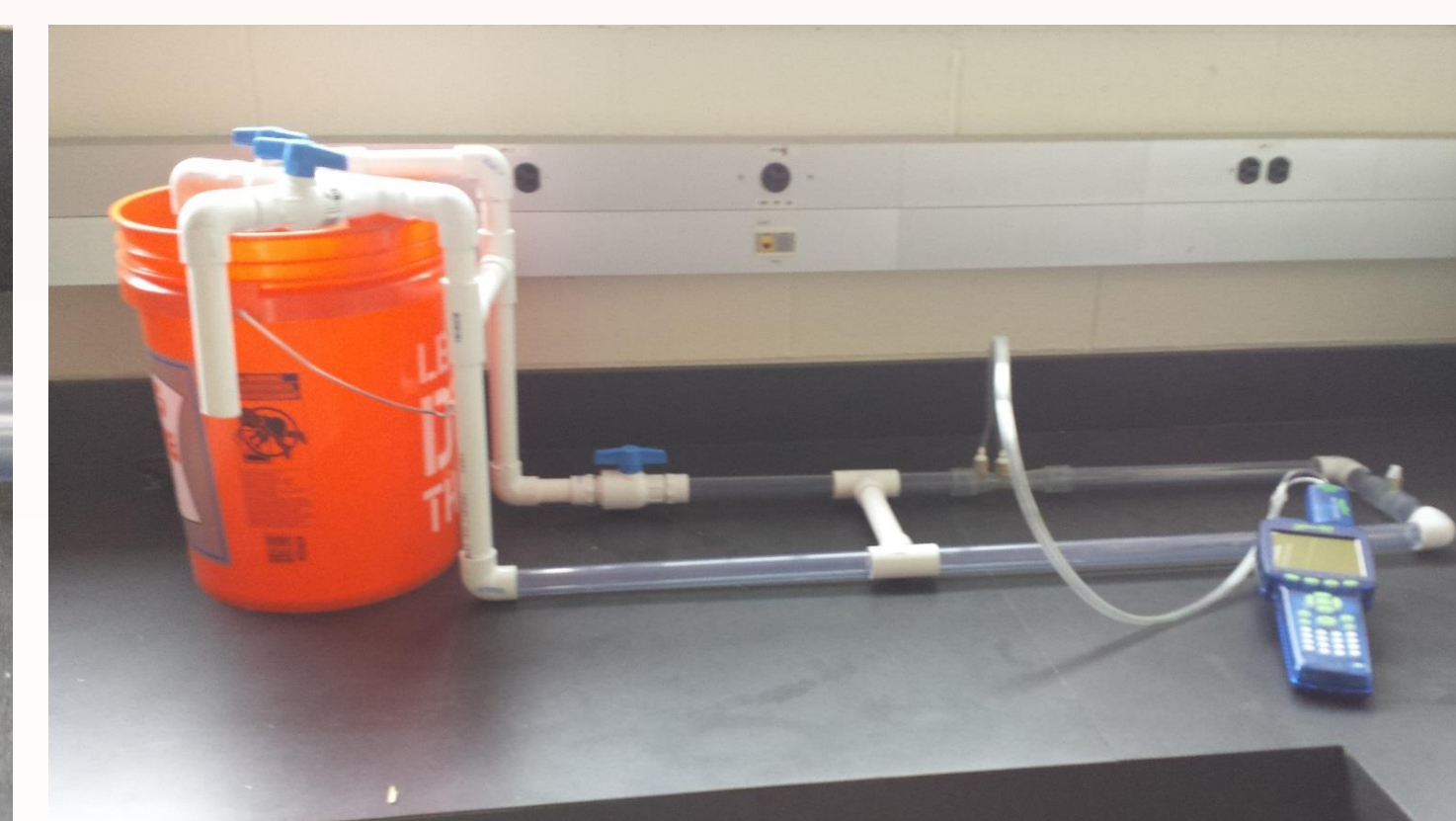
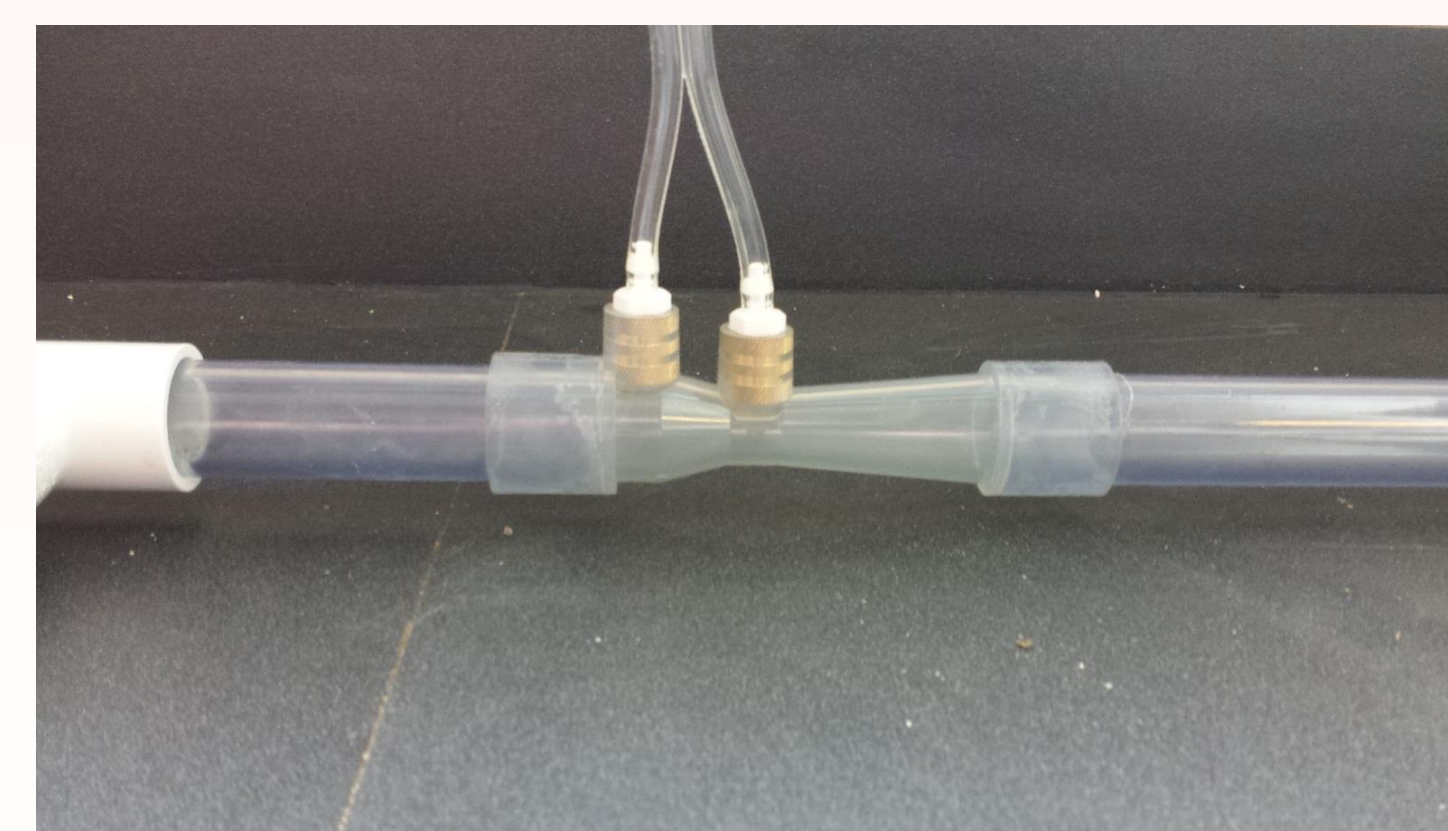
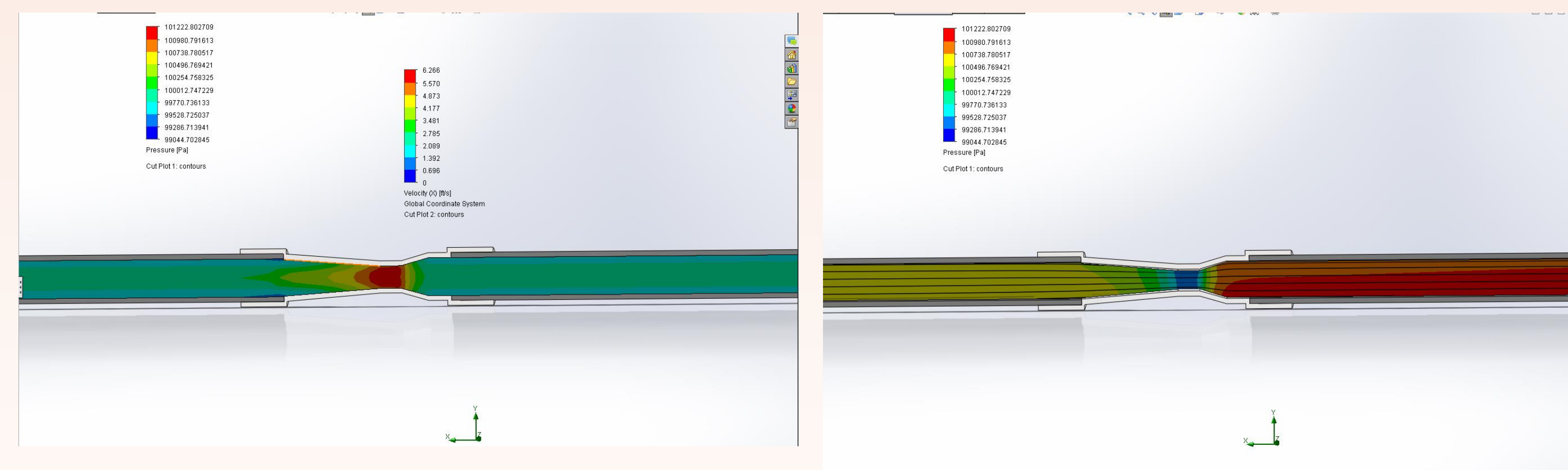
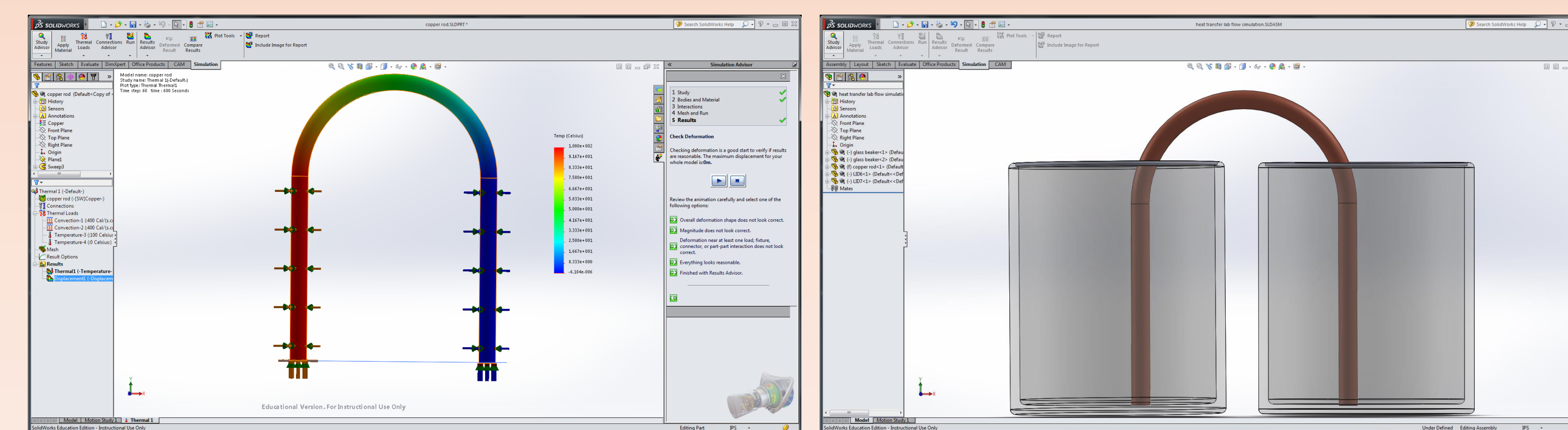
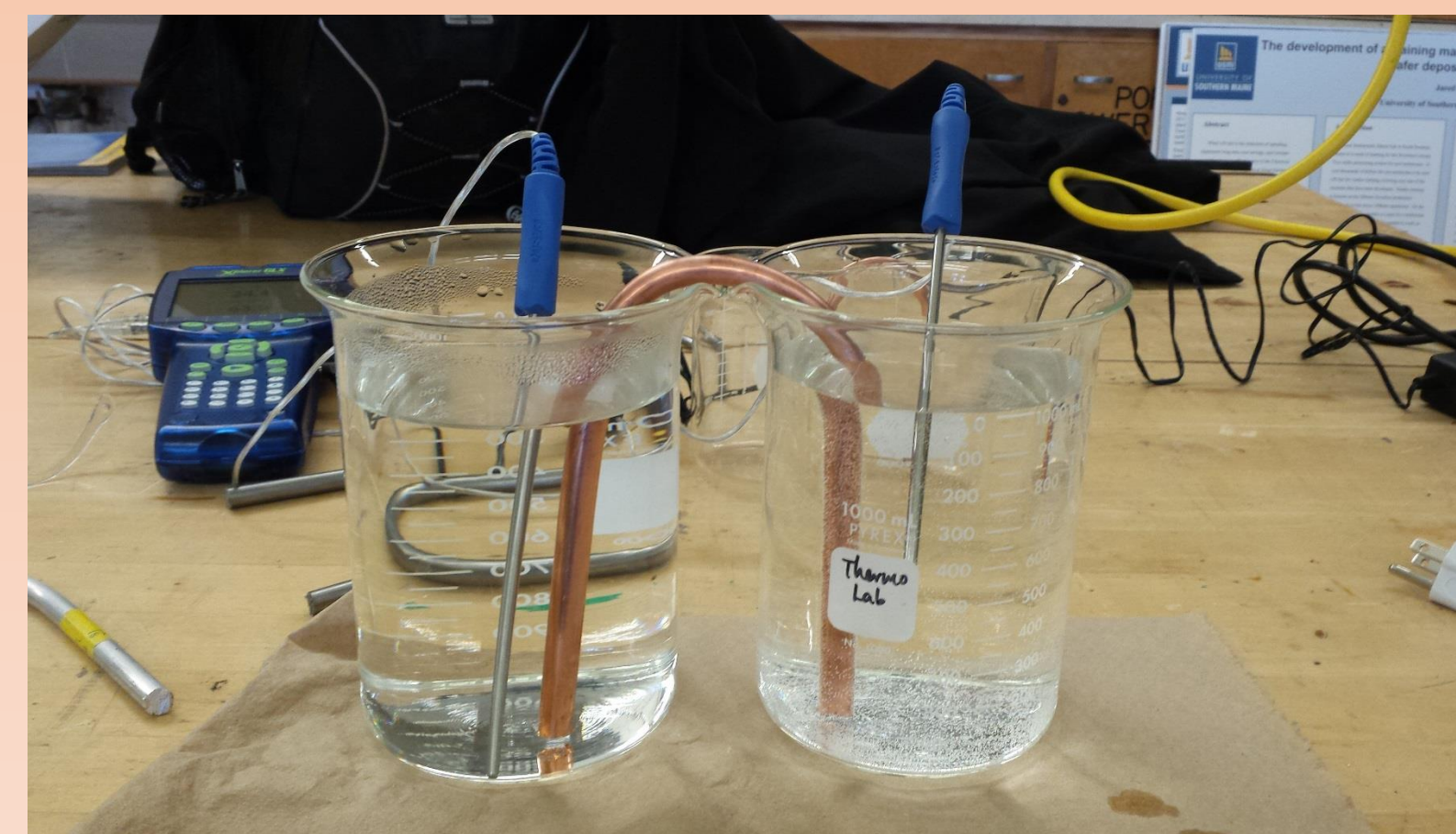
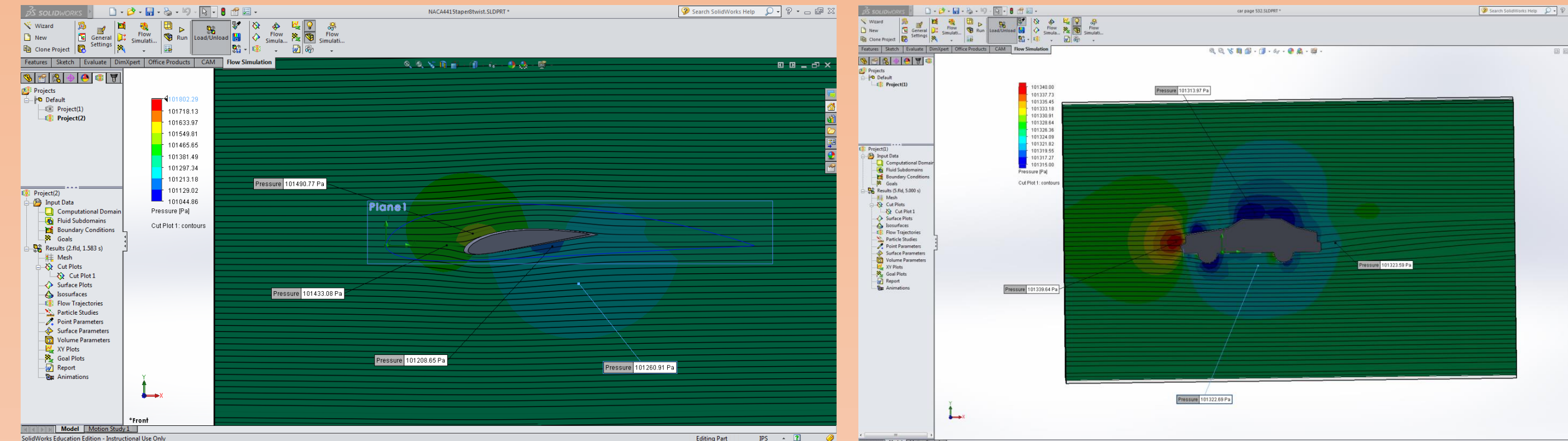
Instructor and Mentor: Dr. Lin Lin

Abstract

This project consists of the designing, building, and creation of instruction manuals for several labs in the fluids and heat transfer fields. Labs for these fields tend to be large and hard to simulate as physical models. This project will solve that problem by creating simulations: in solidworks. Not only will simulations in solidworks make some concepts possible to demonstrate but, it will also expose students to useful software that will be used in the workforce.

Introduction

This project focused on designing, building and modeling several fluids and heat transfer labs. The first lab takes place entirely in solidworks flow simulations. Solidworks flow simulation made it possible to model and analyze a variety of objects as if they were in an air flow chamber. The second lab models how energy flows from a beaker full of boiling water through a copper rod into a beaker full of ice water. Finally the third lab allows for the calculation of mass flow rates through a Venturi pressure sensor.



Solidworks Flow Simulation Lab

The first lab takes place entirely in solidworks flow simulations. Solidworks flow simulation made it possible to model and analyze a variety of objects as if they were in an air flow chamber. The simulations to the left depicts the pressure gradients for several of the parts designed for the lab. Along with these two simulations a library of parts and simulations were created to facilitate a thorough lab.

Heat Transfer Lab

The second lab models how energy flows from a beaker full of boiling water through a copper rod into a beaker full of ice water. This lab allows for analysis of heat transfer coefficient in the transient state, as well as scenarios involving thermal gradients. The figures to the left show the test set up, along with solid works renderings, complete with thermal analysis simulation.

Mass Flow Rate Lab

The third lab allows for the calculation of mass flow rates through a Venturi pressure sensor. This lab was created in a way that allowed for the actual, theoretical, and the simulated flow rates to be compared. Using Bernoulli's equation (figure below) the differences in the pressure readings across the Venturi can be used to calculate the flow rate. The figures to the left show the solidworks flow simulations results, along with the Venturi pressure sensor.

$$\underbrace{\frac{1}{2} \rho v^2}_{\text{kinetic energy}} + \underbrace{\rho g z}_{\text{work done by weight}} + \underbrace{p}_{\text{work done by pressure}} = \text{constant}$$

Acknowledgements: Special Thanks to Dr. Lin Lin, and Chad Seeley for their support throughout this project.



PORTLAND • GORHAM • LEWISTON • ONLINE