

Senior Design Project Description

Company Name	<i>Electrolux North America</i>	Date Submitted	<i>4/16/2020</i>
Project Title	<i>Adjoint Validation Test Stand (ELEC_VALID)</i>	Planned Starting Semester	Fall 2020

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills:

Discipline	Number	Discipline	Number
Mechanical	3	Electrical	2
Computer		Systems	
Other ()			

Company and Project Overview:

Electrolux is based in Sweden and has been a long-standing world leader in appliance manufacturing. Founded 100 years ago (1919), Electrolux started with small appliances like the vacuum cleaner, and has since moved into the major appliances space, with Washers, Dryers, Refrigerators, etc. Electrolux is most commonly known, in this area, under the brand Frigidaire.

One of the key cost drivers in the product development process is the prototype construction and testing. To reduce the number of prototypes required to bring each product to market, Electrolux routinely investigates technologies that have the potential to accelerate our design cycle. One technology that has shown promise is the use of adjoint simulations to optimize non-parametric shapes for better air flow (lower pressure loss, increased efficiency, better flow uniformity, etc). In order to test whether the results of these simulations are accurate an instrumented, mobile test stand is needed that can make precision measurements of air pressure and velocity of multiple prototypes.

Project Requirements:

The objective of this project will be to design and build a test stand capable of measuring several key performance metrics for two different Electrolux prototypes, both of which are currently

being developed using adjoint simulation technology. In addition to the test stand should have a number of other features to be usable in the lab:

- Simultaneous Measurements: the system should be able to measure 5 different pressures and 5 different velocities simultaneously.
- Precision: The system should be able to measure air pressure changes (from ambient) in the



range of 100 Pa with an accuracy of +/- 1 Pa and air velocities in the range of 10 m/s with an accuracy of +/- 0.2 m/s

- Mobility: Lab space is limited and used for many non-technical presentations, so the test stand should e.g. sit on a mobile cart so that it can be easily moved to different locations.
- Open-Source: The instrumentation hardware and software should be open source to prevent reliance on third party (e.g. LabVIEW, MATLAB, DSPACE) license agreements. Preferred solution would be something like an Arduino board with live data display and recording to a spreadsheet (Excel doesn't count against the third-party license in this case). An open source would allow more flexibility for customization and future use without having the constraints of packaged software for license fees, update maintenance, new version obsolescence and training upkeep.
- Isolation and Safety: The test stand should be shielded from its surrounding to prevent interference with the measurement from ambient disturbances (i.e. air conditioning gusts) through appropriate shielding and flow isolation features. It should also shield the user from any safety hazards associated with the high-pressure air and high-voltage electricity that may be entering the test stand.

Expected Deliverables/Results:

- Test Stand
 - Mobile Test Stand
 - Sensors
 - Instrumentation Board/Software
 - Control Board
 - Wiring Harness
- Documentation
 - Wiring Diagrams
 - Software Source Code

Disposition of Deliverables at the End of the Project:

The work product will be displayed at the last Expo then immediately handed over to the supporter unless arrangements have been made to deliver at a future date.

List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):

- Fluid mechanics, instrumentation and data capture