TLEF Project – Final Report

Report Completion Date: (2023/03/28)

1. PROJECT OVERVIEW

1.1. General Information

Project Title:	Virtual Mechanical Models		
Principal Investigator:	Leo Stocco		
Report Submitted By:	Leo Stocco		
Project Initiation Date:	May 2022	**Project Completion Date:**	August 2022
Project Type:	☐ Large Transformation ☒ Small Innovation ☐ UDL Fellows Program ☐ Hybrid and Multi-access Course Redesign Project ☐ Other: [please specify]		

1.2. Project Focus Areas – *Please select all the areas that describe your project.*

☒Resource development (e.g., learning materials, media)

☐ Infrastructure development (e.g., management tools, repositories, learning spaces)

☐ Pedagogies for student learning and/or engagement (e.g., active learning)

☐ Innovative assessments (e.g., two-stage exams, student peer-assessment)

☐ Teaching roles and training (e.g., teaching practice development, TA roles)

☐ Curriculum (e.g., program development/implementation, learning communities)

☐ Student experience outside the classroom (e.g., wellbeing, social inclusion)

☐ Experiential and work-integrated learning (e.g., co-op, community service learning)

☐ Indigenous-focused curricula and ways of knowing

☐ Diversity and inclusion in teaching and learning contexts

☐ Open educational resources

☐ Other: [please specify]

1.3. Final Project Summary – *What did you do/change with this project? Explain how the project contributed toward the enhancement of teaching and learning for UBC students.*

In Robotics and Control Systems courses, students create mathematical models of systems, then design controllers to make them perform tasks. This is done using Matlab/Simulink which is a mathematical tool that displays results using x-y plots.

Matlab has a number of shortcomings. X-y plots are often not very meaningful to novice engineers. Friction, gravity and other effects which are present in real mechanisms are difficult to model, and beyond the scope of Electrical Engineering courses.

In this project, SimulationX is used to develop virtual mechanisms. Complex effects like friction and gravity are accurately computed with little mechanical expertise. Results are displayed using 3D animations. The advanced computational features of Matlab/Simulink are retained through co-simulation.

A SimulationX model gives the impression that students are controlling an actual robot with realistic mechanical dynamics and results that are displayed in 3D animations.

1.4. Team Members – *Please fill in the following table and include **students**, undergraduate and/or graduate, who participated in your project.*

Name	Title/Affiliation	Responsibilities/Roles
Leonel Bravo	Student	Develop all models

1.5. Courses Reached – *Please fill in the following table with **past** and **current** courses (e.g., HIST 101, 2017/2018) that have been reached by your project, including courses not included in your original proposal (you may adapt this section to the context of your project as necessary).*

Course	Academic Year
ELEC 341	2022
ELEC 391	2022

2. OUTPUTS AND/OR PRODUCTS

2.1. *Please **list** project outputs and/or products (e.g., resources, infrastructure, new courses/programs). Indicate a URL, if applicable.*

Output(s)/Product(s):	URL (if applicable):
Solidworks model of mechanism (gripper)	
SimulationX model of mechanism (gripper)	

2.2. Item(s) Not Met – *Please list intended project outputs and/or products that were not completed and the reason(s) for this.*

Item(s) Not Met:	Reason:

3. PROJECT IMPACT

3.1. Project Impact Areas – *Please select all the areas where your project made an impact.*

☒ Student learning and knowledge

☒ Student engagement and attitudes

☐ Instructional team-satisfaction

☐ Teaching practices

☐ Student wellbeing, social inclusion

☐ Awareness and capacity around strategic areas (Indigenous, equity and diversity)

☐ Unit operations and processes

☐ Other: [please specify]

3.2. Please provide details on each of the impact areas you selected in 3.1. – *For example, explain in which ways your teaching practices changed; how student wellbeing was impacted; how students wellbeing benefited from your project, etc.*

Student learning and engagement were impacted because the gripper model that was developed was used as the basis of the ELEC 341 design project. It also impacted ELEC 391 because student develop their own gripper, to exercise the skills they developed in ELEC 341. They had a very realistic project to work on in ELEC 341 which improved their ability to skillfully develop an actual one in ELEC 391. This improved student success which positively impacted student engagement, and consequently, student learning.

3.3. How do you know that the impacts listed in 3.1/3.2 occurred? – *Describe how you evaluated changes/impacts (e.g., collected survey data, conducted focus groups/interviews, learning analytics, etc.) and what was learned about your project from the evaluation. You are encouraged to include graphical representations of data and/or scenarios or quotes to represent and illustrate key themes.*

Design report were submitted in ELEC 391 demonstrating the anticipated improvements in student learning. In comparison to prior years, there was a greater focus on system design and simulation.

4. TEACHING PRACTICES – *Please indicate if **your** teaching practices or those of **others** have changed as a result of your project. If so, in what ways. Do you see these changes as sustainable over time? Why or why not?*

The project will be adapted, but fundamentally re-used for at least 1-2 years.

5. PROJECT SUSTAINMENT – *Please describe the sustainment strategy for the project components. How will this be sustained and potentially expanded (e.g., over the next five years). What challenges do you foresee for project sustainment?*

The specific mechanism will be changed over time, but the fundamental structure of the design projects will persist. The latest version of ELEC 391 marks a fundamental shift from a large and complex implementation project, to a simpler project that incorporates more design and less implementation. This approach puts greater emphasis on the skills learned by ECE students in their pre-requisite courses.

6. DISSEMINATION – *Please provide a list of scholarly activities (e.g., publications, presentations, invited talks, etc.) in which you or anyone from your team have shared information regarding this project. Be sure to include author names, presentation title, date, and presentation forum (e.g., journal, conference name, event). These will be included on the TLEF scholarly output page.*

2022 W1 & 2022 W2 ELEC 341 lectures

2022 W2 ELEC 391 lectures