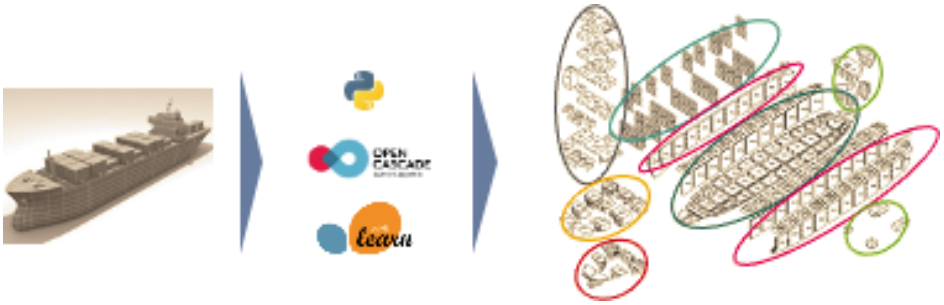
This is a call for MEng students who may be interested in pursuing an international research project. Please review the information below

Project Title: Machine Learning Approach for Modular Assembly Planning in Large-Scale Products

This MEng Project is equivalent to up to 3 1000-level courses

Project Description:



Background

Assembly planning for large-scale products (e.g. shipbuilding, chemical plants or construction industry) demands highly individual and manual effort. Experts take decisions on modularization or building stages based on complex 3D-Models to slice the product in manageable objects. Furtherly detailed assembly sequencing tasks are executed to target a just-in-time scheduling for each module. The orchestration of multiple involved companies with continuously changing schedules is a cognitively demanding job. The decision-making process on dividing the final product in smaller pieces is influenced by multiple factors like geometric feasibilities, interfaces between modules, resource capabilities, internal and external schedules etc.

Current research in assembly planning is focusing on developing algorithmic decision support systems. These systems are mainly focusing on optimization problems in programmatic scheduling, either on high level for the overall project or on low level for sequencing tasks within a module. On the other hand, unsupervised learning techniques evolve rapidly to identify patterns and clusters in complex data structures. Applying these techniques to the modularization problem of large-scale products can be beneficial for a profound decision-making process. The automatic clustering is a promising approach to fill the gap between high and low level scheduling problems and thus is the basis for a hierarchical job scheduling approach.

Problem Statement

The process of slicing complex 3D-Models into manageable assembly modules or stages is a highly cognitively demanding job. Small errors during this early planning phase can cause project delays, increased costs and decrease of quality. Unsupervised learning techniques promise an algorithmic approach to face these challenge considering multiple influential factors at the same time.

Proposed Solution(s)

The goal is to develop a software-tool that makes suggestions for dividing complex large-scale products into manageable modules, considering multiple restrictions. The tool should be able to read and analyse

CAD-files. Open-source CAD libraries or APIs of commercial CAD software offer a high flexibility to programmatically analyse large assemblies in 3D. Clustering algorithms from unsupervised learning techniques can be applied to allocate single parts to reasonable subassembly modules. Further restrictions and constraints (e.g. the minimization of geometrical interfaces between modules) can be additionally implemented with heuristic local search approaches. Furthermore, schedules and resource capabilities for executing assembly tasks can be considered in a hierarchical manner, either on high- or low-level task descriptions.

InVEST Project Participation: As an InVEST project student you will be part of a team of 3-4 students from UofT and a partner international university. You will work as a team to tackle the project and communicate and collaborate virtually as much as possible. The InVEST program provides value-add services to these projects including: access to and training in state-of-the-art virtual collaboration and communication tools, special training sessions on important aspects such as effective team-work and intercultural understanding and communication. The program as a whole is designed to not only enhance technical skills but also teach effective communication and team-work strategies and enhance intercultural understanding in the context of geographically distributed teams. As such, you will be expected to participate in both the technical aspect as well as the intercultural and virtual teamwork value-added activities. These will be executed in 5 sessions of 90 minutes each and 5 hours outside-class activities.

Faculty Advisors:

Dr. Chi-Guhn Lee

Professor, Mechanical & Industrial Engineering

University of Toronto, Canada

Sören Münker, M. Sc.

Research Associate, Model-Based Systems Department

RWTH Aachen, Germany

Program: M.Eng, Mechanical Engineering

Technical Expertise Required:

- Interest in assembly planning systems
- Profound programming experience (python or C++ recommended)
- High motivation and self-reliance

Availability: May 2021 – April 2022

Application Deadline: Open until filled

Interested students are encouraged to apply by sending the documents listed below with the subject line: “InVEST Project Application” to info.invest@utoronto.ca and CC tobi.edun@mail.utoronto.ca.

1. Resume/CV
2. Copy of your most recent transcript (does not need to be official transcript, ROSI copy acceptable)
3. Statement of Interest demonstrating your motivation for pursuing the project and what you will bring to this collaborative project