Project title: Building an autonomous hybrid metal additive manufacturing system
Supervisor: Prof. Yu Zou (MSE & cross-appointment at MIE)
https://www.zou-mse-utoronto-ca.net/
Disciplines required: ME or EE
Background: Mechatronics, control or automation
4th year undergraduate students or MEng students
Start date: Summer or Fall 2021
End date: one semester or one year
Application documents: CV, transcripts, short summary of research experience (if available)
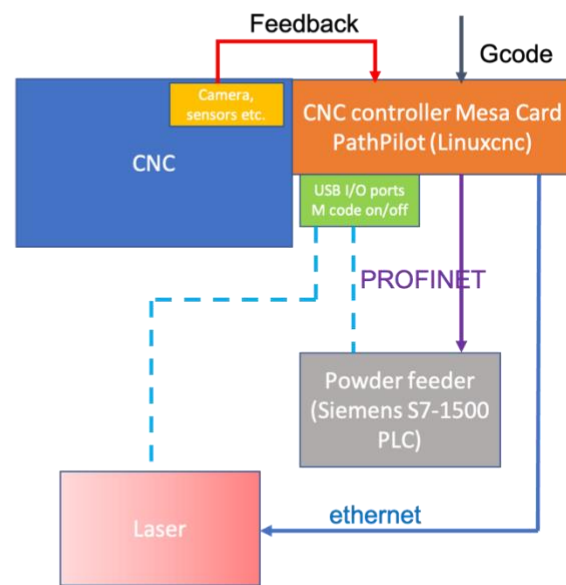

Lasertec 65 DED hybrid machine

DED process   Milling process

Possible control system integration

Background
Metal additive manufacturing (M-AM), or metal 3D printing, will fundamentally change the entire manufacturing industry, from aerospace to biomedical sectors, by 2025 (McKinsey Report, 2019). A key hurdle for the mass adoption of AM is the formation of flaws, during the manufacturing process, leading to inconsistent product quality. To reduce defect density, it is essential to identify optimal processing parameters for each material/geometry. Ideally adaptive control of the parameters during manufacturing is highly desirable, especially for parts made of multi-materials and with complex geometries.

Project description
At the current stage, we're designing a hybrid vertical milling + directed energy deposition (DED) M-AM system. A hybrid M-AM system is advantageous in that it makes and

postprocesses parts within one integrated process, and that it postprocesses aeras that may not be accessible after the prints are finished. We are building the machine from scratch with the subsystems, i.e., laser source, deposition head, powder feeder, CNC vertical mill, etc, for the flexibility and openness of an in-house built machine. The students will work in team with other students to integrate the subsystems of the machine. The students will focus on the mechanical and electrical integration to make sure all components and the control system coordinate properly.

Preferred experience
- Background in mechanical engineering or electrical engineering
- Experience with microcontroller, PLC and control system design
- Basic programming C++, Python, Gcode knowledge
- Experience with LinuxCNC or similar control software is an asset
- Experience with Siemens PLC is an asset
- Experience with PROFINET is an asset