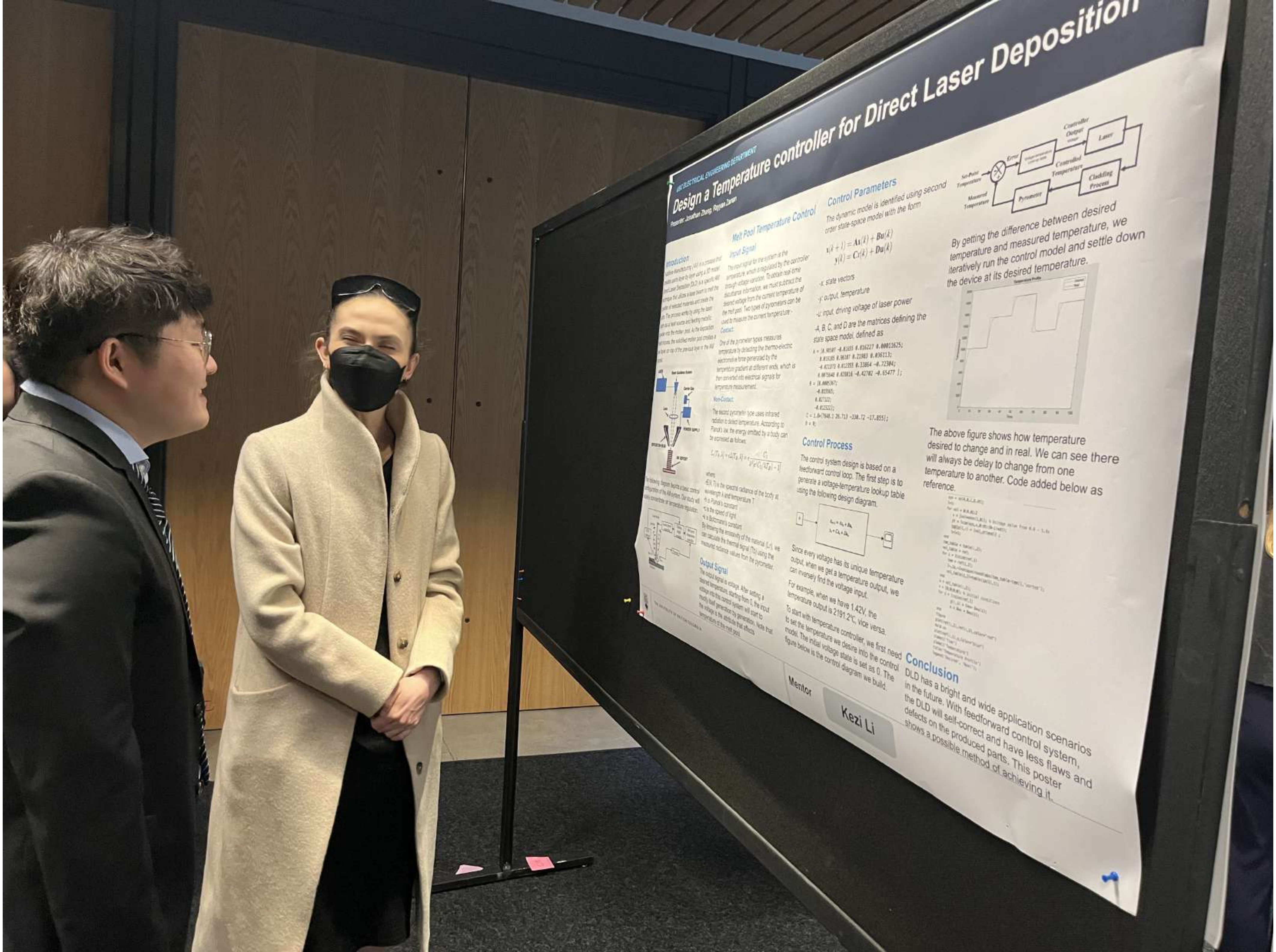

Design a Temperature controller for Direct Laser Deposition
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Introduction
Melt Pool Temperature Control
Input Signal
Output Signal
Control Parameters
The dynamic model is identified using second order state-space model with the form
x(k+1) = Ax(k) + Bu(k)
y(k) = Cx(k) + Du(k)
-x: state vectors
-y: output, temperature
-u: input, driving voltage of laser power
-A, B, C, and D are the matrices defining the state space model, defined as
Control Process
The control system design is based on a feedforward control loop. The first step is to generate a voltage-temperature lookup table using the following design diagram.
Since every voltage has its unique temperature output, when we get a temperature output, we can inversely find the voltage input.
For example, when we have 1.42V, the temperature output is 2191.2°C, vice versa.
To start with temperature controller, we first need to set the temperature we desire into the control model. The initial voltage state is set as 0. The figure below is the control diagram we build.
Set-Point Temperature
Error
Controller Output
Laser
Controlled Temperature
Cladding Process
Pyrometer
Measured Temperature
By getting the difference between desired temperature and measured temperature, we iteratively run the control model and settle down the device at its desired temperature.
Temperature Profile
The above figure shows how temperature desired to change and in real. We can see there will always be delay to change from one temperature to another. Code added below as reference.
Conclusion
DLD has a bright and wide application scenarios in the future. With feedforward control system, the DLD will self-correct and have less flaws and defects on the produced parts. This poster shows a possible method of achieving it.
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