Overview
We were tasked with separating a mixture of metal powders after they are used in a 3D printing process so that they can be recycled. This saves money and lets the sponsor print with multiple materials at the same time. The difficulty in this problem is that the metals we have to separate are fairly similar in many of their properties.

Objectives
We needed to separate stainless steel 17-4, Inconel 718, and GrCop-84. It was preferred that this be a dry separation technique, and a separation rate of 50 g/hr was required by the sponsor.

Approach
- We started out trying to separate based on density, as that's the most obvious difference between the materials
- As it turns out, the densities of these materials are too similar to reliably separate them accordingly
- We considered using a coating method, to make one powder hydrophobic and another hydrophilic prior to printing with it
- This was nixed because it required a wet separation method and increased the complexity substantially compared to using magnets, which showed promise
- Research into the Curie Temperature of the materials we were using showed us a ‘hidden’ material property we could use to separate the powders
- We designed a conveyor system to move the powders through a system of magnetic fields and different temperatures, causing different materials to become magnetic at each step and separating them from the others

Outcomes
- X Material Processing will save $1500-$3000 per build with this technology
- Material is fully recyclable, should reach high purity again
- Process is highly scalable
- Prototype works, has higher throughput than specified by sponsor
- System can be expanded to other material systems where each material has different Curie Temperature

Our Final Prototype