



Department Project Information

Department Name	MEES	Date Submitted	07/15/2025
Project Title	WAAM Wire Preparation Machine (UNCC_ME_WAAM)	Planned Starting Semester	Fall 2025

Senior Design Project Description

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills:

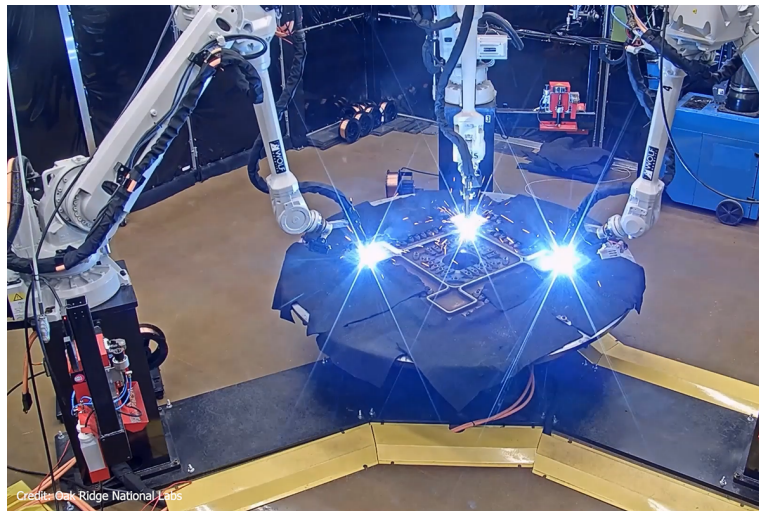
Discipline	Number	Discipline	Number
Mechanical	5	Electrical	0-1
Computer	0-1	Systems	0
Other ()			

Project Overview:

With a rapidly increasing global demand for manufactured metallic components, there is a high need for the development of new manufacturing methods that can meet this demand in a cost effective and efficient manner. One of the primary goals in the development of these manufacturing methods is to eliminate unnecessary material waste, which brings benefits in both financial and environmental forms. Wire Arc Additive Manufacturing (WAAM) is capable of creating near net shape components and do so at virtually any scale imaginable. Due to the localized shielding of the melt pool, no large enclosing structures are needed, making it possible to build very large parts at high deposition speeds. These parts can be made with single or multiple nozzles at the same time. The image below shows the Medusa system developed at Oak Ridge National Lab.



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WAAM is a fully autonomous process. While much more complicated than the FDM methods used in 3D desktop printers, there are many similarities. A part is created by depositing material layer-by-layer until the final desired shape has been reached. The WAAM process, however, is conducted at extremely high heat to allow for fusion of the material. This requires the wire material to be as clean as possible as to not introduce impurities into the melt pool, which can lead to catastrophic failure of the part due to high porosity flaws. Furthermore, if dirty wire goes through the wire feeder and tubes, it will eventually cause a clog, causing an abrupt stop in the deposition process, ruining a part.

Improper handling and storage of wire material leads to dirty and heavily oxidized wire when dealing with certain materials, especially with materials like magnesium and some steels. It is therefore necessary to clean the material before it can be used. Doing this process manually is hard labor and takes a very long time. There is a need for a machine that can properly clean and respool the welding wire before it is used in manufacturing.

Project Requirements:

The team will design, build and test a machine that can be loaded with a 10-pound size spool of 1.19 mm wire and then can automatically straighten and clean the wire as it respools it onto an empty spool. The method of contaminant removal, straightening, and spool actuation is entirely up to the team. Research should be conducted on current manual methods for cleaning contaminated wire. Care must be taken as to not damage the wire during this process. Care must also be taken to ensure that the cleaning process does not significantly remove actual metal from the wire so that the diameter of the wire is not decreased by too much. The machine must also be able to accomplish this with any amount of starting material on the spool, so the speed of the guiding mechanism must be adjustable depending on the diameter of the spool. Given that this machine will have to clean wires of different levels of contamination, the machine may run the wire multiple times in order to remove all contaminants – single cleaning runs are not required. The goal is to ensure the wire is ready for deposition. The functionality will be tested by visual inspection, diameter measurements, respool quality, and possibly the deposition of material and analysis of the subsequent material quality (microstructure, microscope, etc.). Below are images of clean and heavily oxidized weld wire.



Expected Deliverables/Results:

- CAD and engineering drawings for the prototype
- fully functioning weld wire cleaning machine
- testing data proving that the machine accomplishes what it is supposed to (testing methods to be discussed)
- user manual

Disposition of Deliverables at the End of the Project:

Hardware developed is the property of the mentor and department. Typically, the work product is displayed at the last Expo then immediately handed over to the mentor. Please confirm your expectation in this section.

List here any specific skills, requirements, specific courses, club affiliation, knowledge needed or suggested (If none please state none):

- machine design
- electric motors (stepper/servo) and control
- machining (mill/lathe/etc.)
- basic electric circuit design (optional)