

Problem & Objectives

- Current system relies on operator manually spreading and estimating fabric cut length
- Operation is based on a complex cut ticket with limited fabric verification, increasing the chance of operator error
- Remaining fabric roll length is determined via weigh station, adding time and inventory inaccuracy
- **Objective:** Automate the spreading, measuring, and cutting functions while ensuring simple operator loading and unloading

Target Specifications

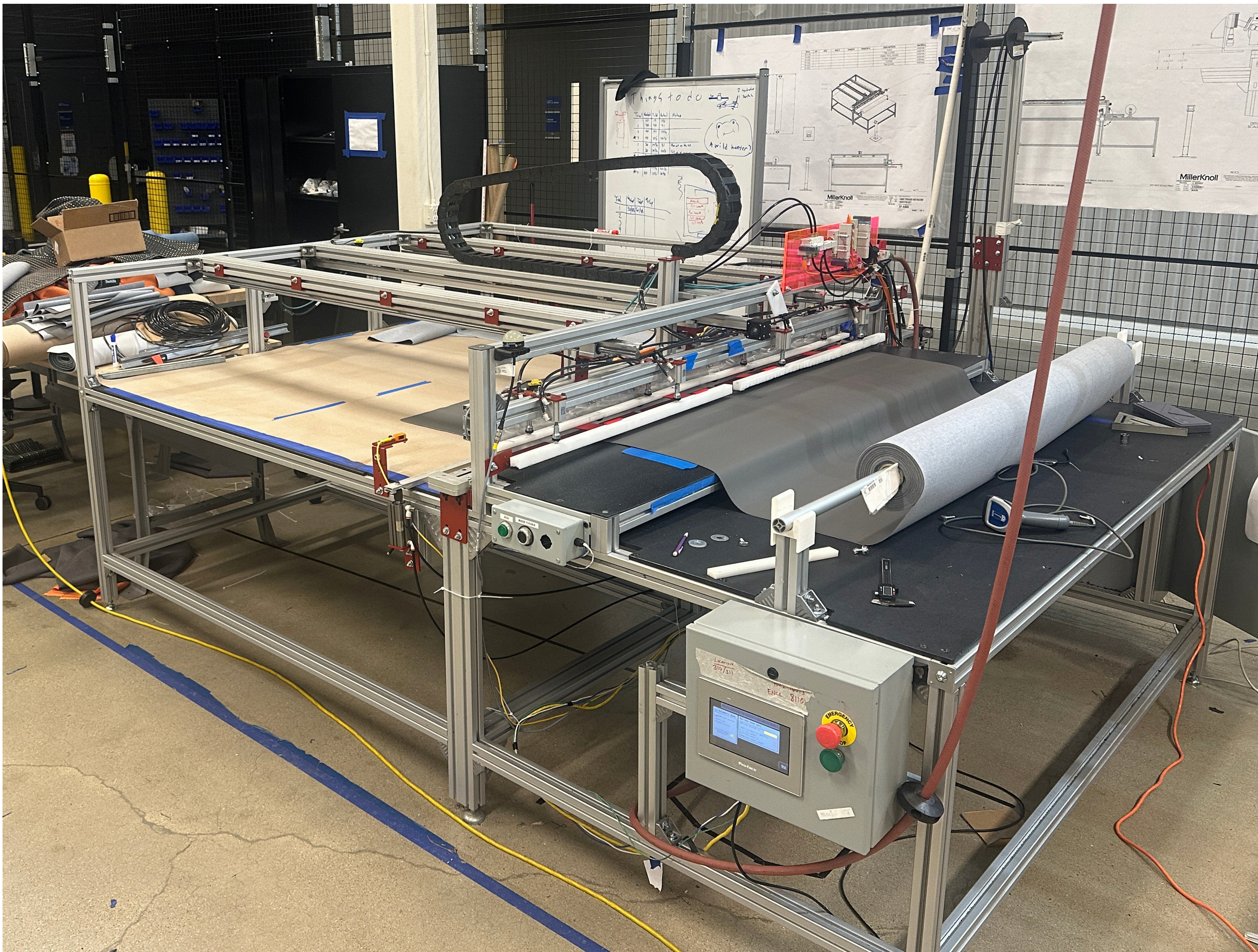
- Capable of cuts ranging 20-60 inches
- Accuracy Target: 0-1", no undercuts
- Single-Layer Cycle Time: <20 seconds (for a 40" layer stack)
- Automatic and Manual operating modes
- Barcode-based cut ticket and fabric identification
- Remaining fabric length displayed back to operator
- All above demonstrated on a 30-piece runoff

Final Concept Selection

Fabric Spreading	Belt-driven gantry with bar clamp
Material Handling	Pneumatic-controlled bar clamp
Length Measurement	Servo position tracking
Power and Controls	120V architecture with Allen-Bradley PLC

This combination aims to balance speed, consistency, simplicity, and integration with the existing process.

Full Machine Build



Gantry / Clamp / Fork Plate Detail



Prototype Design Breakdown

Mechanical:

- A Bosch-extrusion table with a smooth starboard surface
- Fabric roll stand with rod cradles
- Moving gantry built around an MDX+ integrated servo powering a 72" belt drive.
- Falcon IV linear cutter reused from current system

Electrical/Controls:

- 120V Architecture powering Allen-Bradley Safety CompactLogix 5380 PLC and a 7" ProFace ST6000 series HMI
- Photoeyes and distance sensor to aid and confirm cutter and gantry operation
- Barcode Scanner for inputting cut criteria
- Servo absolute positioning used to determine spread
- E-Stop, manual E-Stop reset, safety relays, and an air dump

Pneumatics:

- 20mm stroke SMC cylinders to actuate gantry and pre-cutter clamps
- 50mm stroke SMC cylinders to actuate retractable fork plate and material-holding bar clamp

Results & Impact

- Achieved 40" Layer Runoff Cycle time of <18s
- Improves material tracking in logging and displaying remaining fabric inventory via HMI display
- Effective cut ticket rework into comprehensive barcode system
- Prototype deliverable includes design packet for implementation of extended-length gantry variant at MillerKnoll facilities

Acknowledgements

Industry Sponsor: MillerKnoll
GVSU Faculty Advisor: Sunghwan Joo, PhD
Special Thanks to Nathan Hoffman, Jon Hamm, and Pam Johnson from MillerKnoll for their technical guidance and project support.