Mechanical Fixture for Surface Treatment Process Control

INTRODUCTION

Current repair methods for thermoplastic contoured surfaces utilize a 5-axis robot arm requiring extensive training and setup.

Problem Statement
Our project aims to reduce complexity by creating a 3-axis fixture that securely mounts to curved surfaces enabling complex surface treatment operations.

CORE FUNCTIONS

Functionality:
- **Attachment**: Able to attach to curved surface securely
- **Flexibility**: Able to conform to cylindrical curved surfaces (120in minimum radius)
- **Control**: Manipulate toolhead in XYZ using G-code

Specifications:
- **Speed**: 0.05-0.5 in/sec
- **Curvature**: 120in radius
- **Z-axis travel**: 4 in
- **Max Treatment Area**: 2ft x 2ft
- **Target Weight**: 80lbs total

FUTURE WORK

- Improve stability in non-horizontal orientations, especially while mounted upside down.
- Optimize tool attachment.
- Switch to pneumatic suction cup system.

MANUFACTURING

- Additive Manufacturing
- Mill/Lathe/Drill Press
- Commercial off the shelf parts

CONCLUSION

- The fixture utilizes carriages running along flexible tracks with a rack/pinion system along the curved axis
- Suction cups attach the fixture to the surface
- A z-axis ball screw was also added as a 3rd axis
- 15% weight reduction while adding a 3rd axis

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