Science and Engineering Research Program
Project Description

Institute:
Institute of Assembly Technology and Robotics- Leibniz University

Project title:
The Design and Validation of an Air Nozzle Digital Twin Model

Project description:
Automated assembly systems require greater flexibility due to shrinking margins, shorter project cycles, and sustainability demands. Feeding technology, accounting for 20-50% of production costs, is key. Vibratory conveyors orient small parts mechanically, but systems independent of part structure are needed. The Institute of Assembly Technology and Robotics (match) has explored using compressed air for flexible part manipulation. Combining aerodynamic orientation with image processing could further enhance feeding systems and automation flexibility.

The prototype re-orientation system uses 6mm Festo adapters attached to a machined or 3D-printed block with 3mm holes as nozzles. Creating a digital twin of these nozzles would improve simulation accuracy for part manipulation. The project tasks are:

1. Create a ***3D model*** of the nozzle using software like Autodesk or Blender, and export it as an STL file.
2. Import the model into a Python-compatible flow simulator (e.g., Omniverse Flow or Pyrosim) to ***simulate airflow***, allowing the user to set nozzle pressure and distance and output the resulting ***force*** of the air stream.
3. Design a ***force measuring rig*** to measure the force applied by the air outputted from the nozzle at a distance. One suggestion is to use a 3D printed 'force deflector' coupled with a strain gauge controlled by an Arduino.
4. ***Validate*** the simulation by comparing simulated forces with forces generated by ***real-world*** experiments
5. ***(Optional)*** Analyse how adding netting or mesh in front of the nozzle affects the applied force in both simulation and real tests.

***Desired skills*:**
-Experience with 3D Modelling
-Experience with 3D printing
-Experience with PyBullet / NVIDIA Omniverse
-Python Coding Experience

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