NRI:FND: Collaborative Mobile Manufacturing in Uncertain Scenarios

NRI-CmmUS-LSU

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https://nri-cmmus-lsu.github.io/dist/index.html

Overview: This project develops a scalable, mobile, co-robotic system that leverages robot-robot collaboration with trained human supervisors for large-scale manufacturing applications, focusing on finishing operations for composite wind turbine blades.

Key challenges: Specific barriers hinder the automation of finishing processes: **1)** final part shape may vary from the planned geometry, **2)** nature and duration of the task vary from one part to the next, and **3)** task completion is based on human judgment and experience.

Research and Scientific Impact

1) Design of perception frameworks for quality assessment in composite laminates. Polarized computational imaging approaches and state-of-the-art computer algorithms have been used to detect irregularities in manufactured parts.

Fig.1. Polarized imaging samples [1]

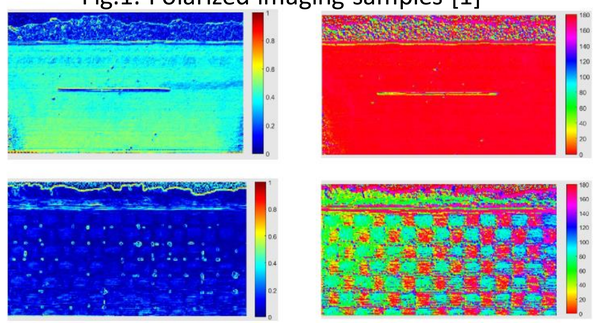
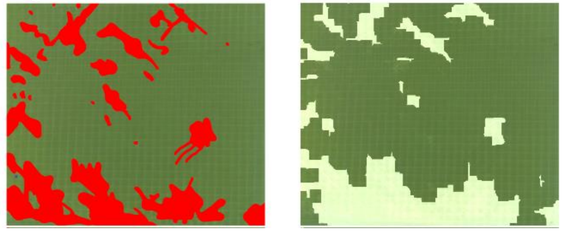


Fig.2. Defects: manual vs automatic detection [2]



2) Design of novel control-planning architectures for robots operating in dynamic environments. A novel expert system for robotic manipulators performing sanding tasks on work surfaces is created. It adjusts the velocity of the robotic manipulator based on the estimated surface quality. Optimal path planning and coverage path planning strategies are designed for autonomous sanding for surface defect removal.

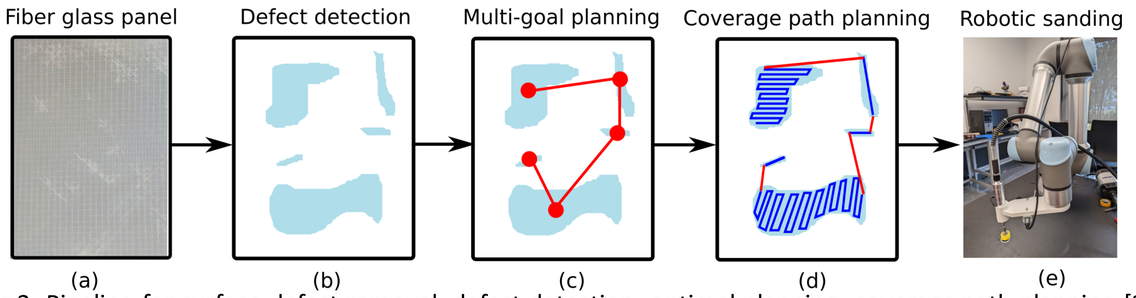


Fig.3. Pipeline for surface defect removal: defect detection, optimal planning, coverage path planning [2]

Broader Impacts: Proposed architecture is applicable to large-scale manufacturing in industries such as: energy, transportation, aerospace, maritime, construction.

Outreach: LSU ME Capstone team is designing and building a scaled wind blade. Several components of the project have been demonstrated at ENGage LSU (middle school children).

Fig.5. Initial wind blade prototype

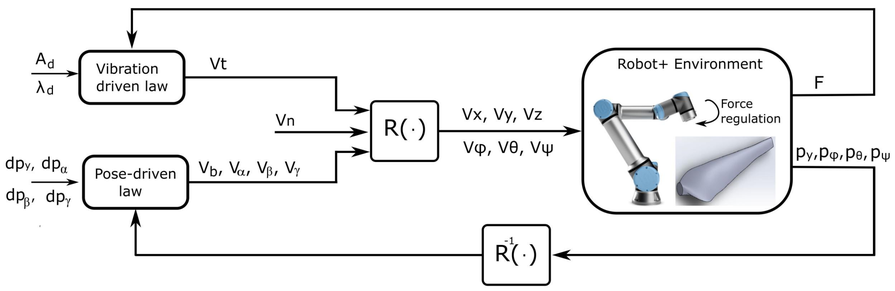


Fig.4. Velocity control system for smart surface defect removal [3]

References:

[1] Y. Ding et al. "Next-generation perception system for automated defects detection in composite laminates via polarized computational imaging", CAMX Conference, 2021

[2] J. Oubre et al. "Towards a fully autonomous robotic system for detection and removal of surface defects in fiber glass panels", submitted to IFAC ICONS, 2022

[3] J. Nguyen et al. "Robotic Manipulators Performing Smart Sanding Operation: A Vibration Approach", accepted at IEEE ICRA 2022

2022 NRI & FRR Principal Investigators' Meeting
April 19-21, 2022

Award ID#: 2024795