# TASK-ORIENTED AGILE WORKCELL—Automatic Robot Taping

Professor Chen I-Ming, Nanyang Technological University
MICHEN@ntu.edu.sg

WP5

## Problem Statements

•The process of taping (covering objects with masking tapes) before conducting surface treatments (such as plasma spraying and painting) is tedious and arduous.
•Automating the taping process requires 3D model construction of workpieces, efficient robot path planning, surface covering methods and correct tape attachments using special tools.

Taping Workpiece Sample

## Research Objective

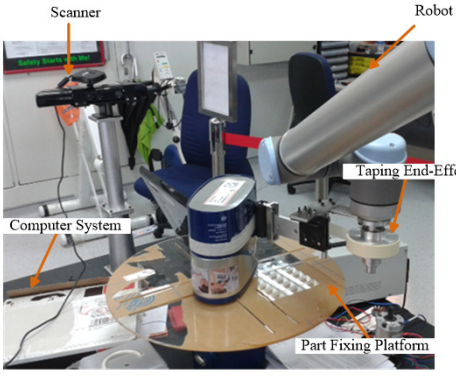
To develop an automatic robotic system and the corresponding methods to do surface covering process using masking tapes.

## Solution

•An automatic system based on a robot manipulator, a rotating platform, a 3D scanner and novel taping end-effectors for taping process.
•The taping path planning method to cover region of interests is developed for variety of surfaces.
•Collision avoidance and taping path optimization method.
•A useful application package for industrial processes such as plasma spraying, surface protection.

## Concept of Operation

The system includes a 3D scanner for 3D model reconstruction, a platform to fix the workpiece, a taping robot, and the robot taping tool. The platform can either be a simple fixed base or a rotating platform. The customized design of the end-effector is required in order to meet the proper taping requirement.



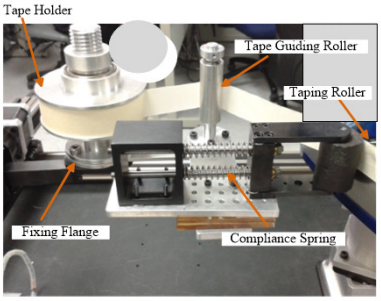

Automatic taping system

1. Scan the object for taping and load the model
2. Calibrate the robot-object position and identify the area to tape
3. Define the taping method and the parameters (Taping method, speed, overlaps ratio and initial Pose)
4. Generate the taping paths for the area taping, tape cutting phase and plan the robot path
5. Robot execution

Singapore Provisional Patent : **Robot Taping: Taping System And Taping Strategy**. Ref No.: PAT/111/15/15/SG PRV.
Inventors: CHEN I-Ming; YUAN Qilong; LEMBONO Teguh Santoso

## Tool Design

•Taping end-effector to handle tapes and actual taping process.
•**Tape holder** to hold the masking tapes.
•**Tape roller** to attach tape to surfaces.
•"Compliance spring" mechanism to allow tolerance at tape end, and with distance sensors added, force feedback is possible.
•**Tape cutter** to separate tape segments.



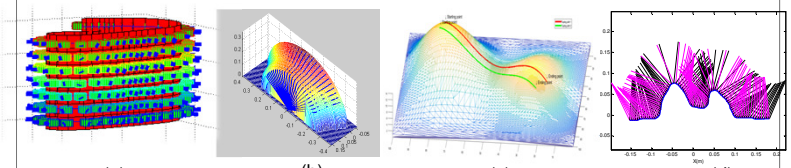

Taping tool VA 1.0

Taping tool VB 1.0

Taping tool VA 2.0

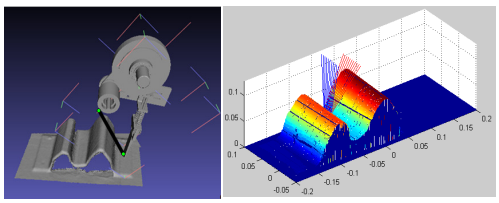
## Taping Path Planning

Separate surfaces into different classes based on the different geometric features and apply the corresponding methods.
•Cylindrical-like surface (a)
•Rotational Symmetrical surfaces (b)
•Freeform surface (including flat surfaces) with no grooves (c)
•Surfaces with grooves. (d)



(a) (b) (c) (d)

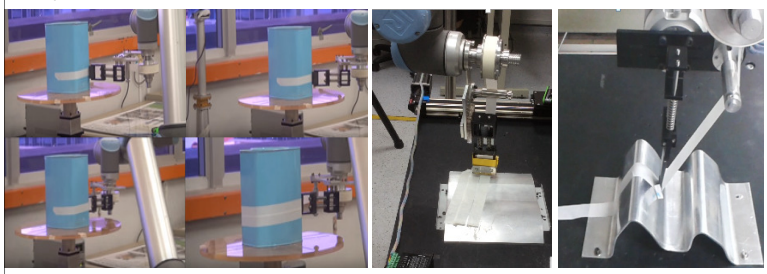
Collision avoidance between the taping tool and workpiece
•The body of the tool and the tape cannot collide with the environment.



Collision model of the tool and the workpiece

## Robotic Taping Execution

•Example of taping a cylindrical surface is shown in Figure (e).
•Examples of taping freeform surfaces and grooves are shown in Figure (f), and (g).
•The introduced strategy can cover the majority of the parts. More complex workpieces taping is in working progress.
•Extremely difficult minor parts can be handled by other methods or by human work.



(e) (f) (g)

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Industrial Robotics Program
NUS National University of Singapore
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