Automated Shingling

Team 1, Robot Autonomy
Spring 2016

Outline

The Problem

Background

What we’re doing

Surface Tessellation

Shingle Preparation

Trajectory Generation

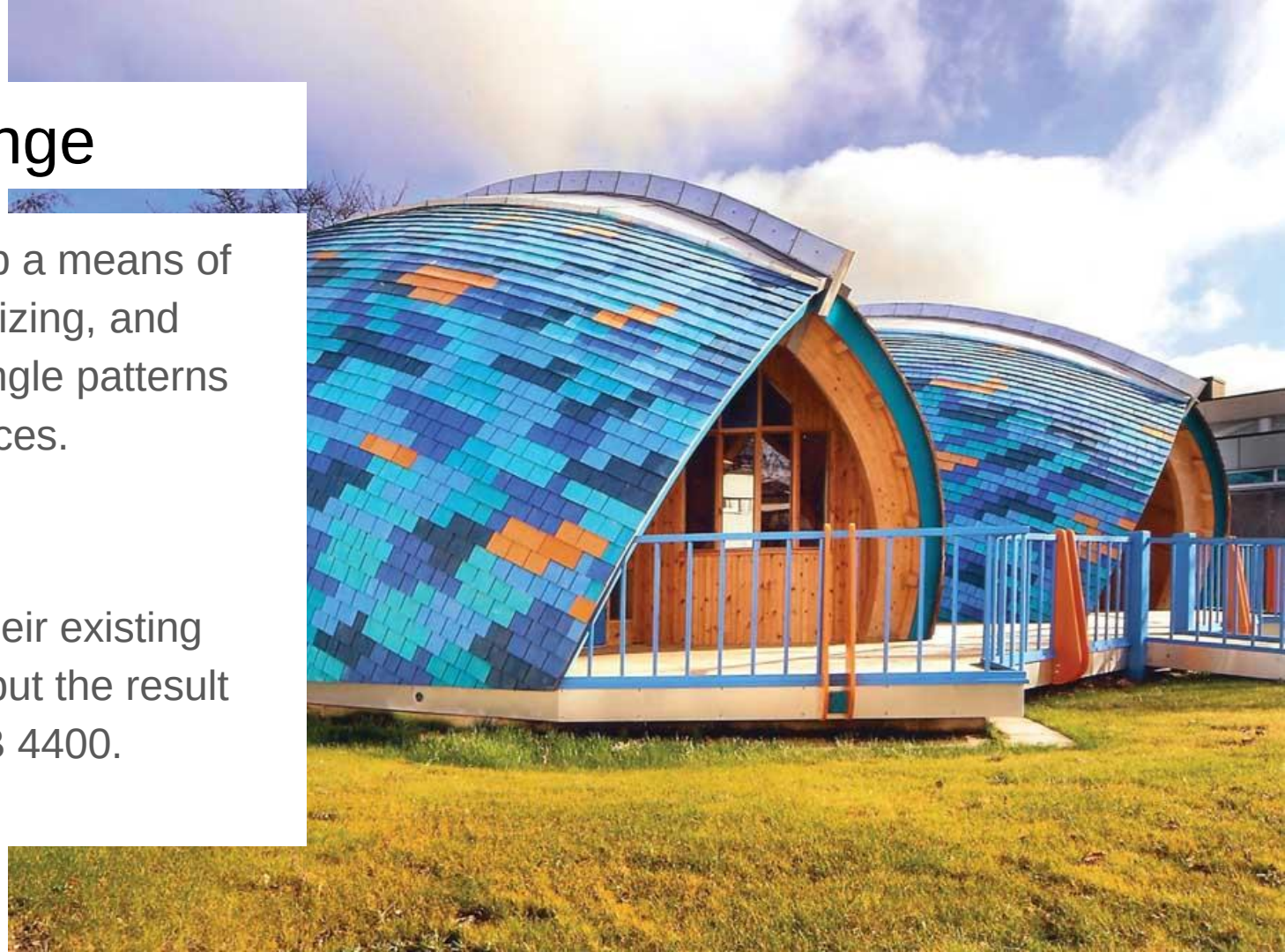
Work Object Definitions

Final Product

The Challenge

Give the dFAB lab a means of generating, visualizing, and implementing shingle patterns for complex surfaces.

Integrate it with their existing workflow and output the result using an ABB IRB 4400.



Background

- Shingling are a manual-labor intensive process
- Architects are looking tools for both design and implementation
- Tools used integrated with architect’s workflow

Approach

Software:

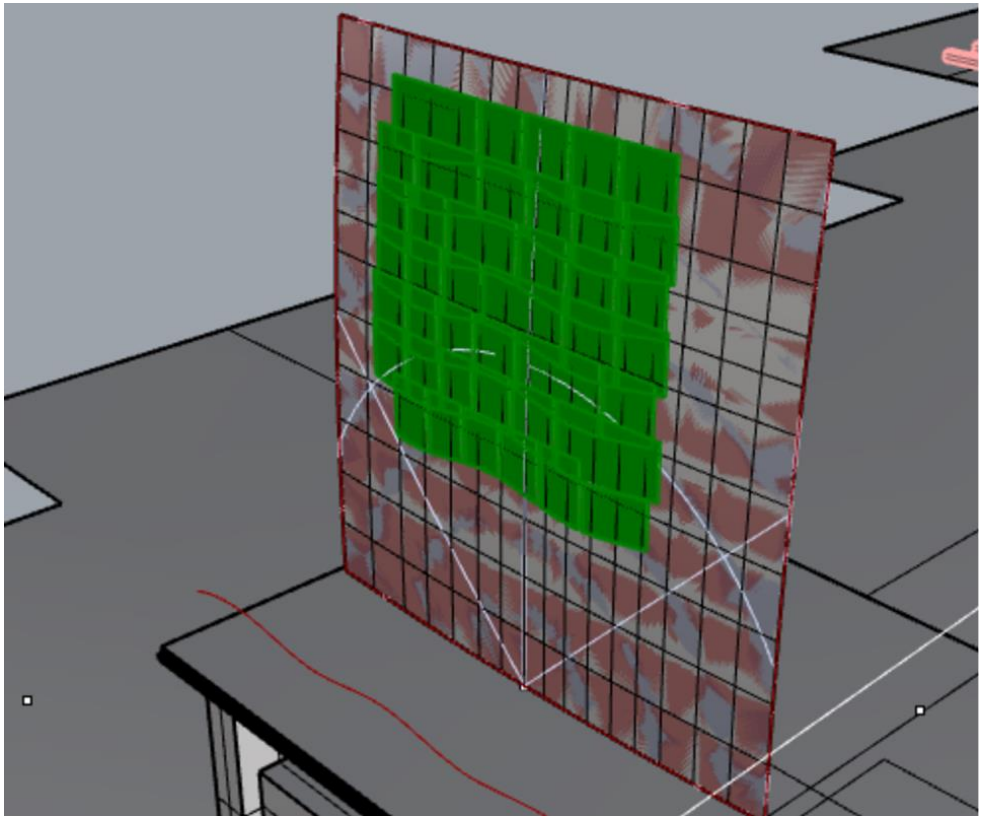
- Rhino
- Grasshopper
- HAL
- ABB Robot Studio

Hardware

- ABB IRB 4400
- Custom End-Effector

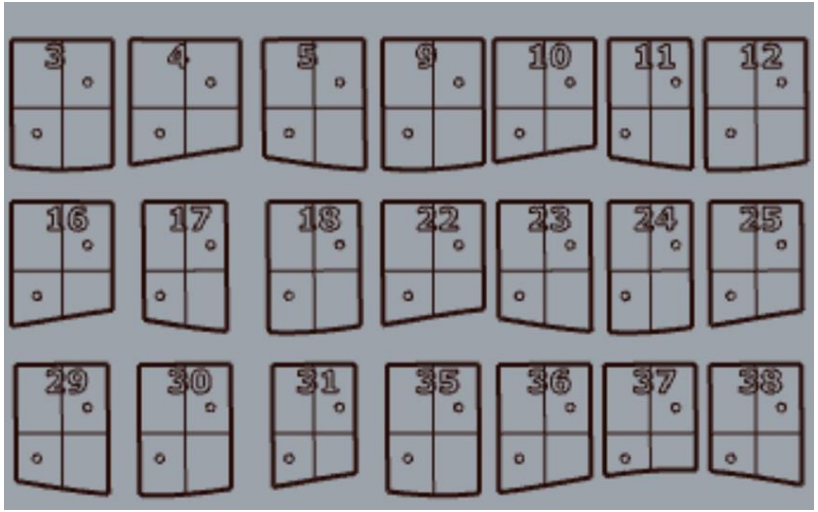
Surface Tessellation

- Break the surface into a grid
- Analyse the grid sequentially and divide into shingles based on the parameters
- Calculate a grasp point and grasp normal for each shingle



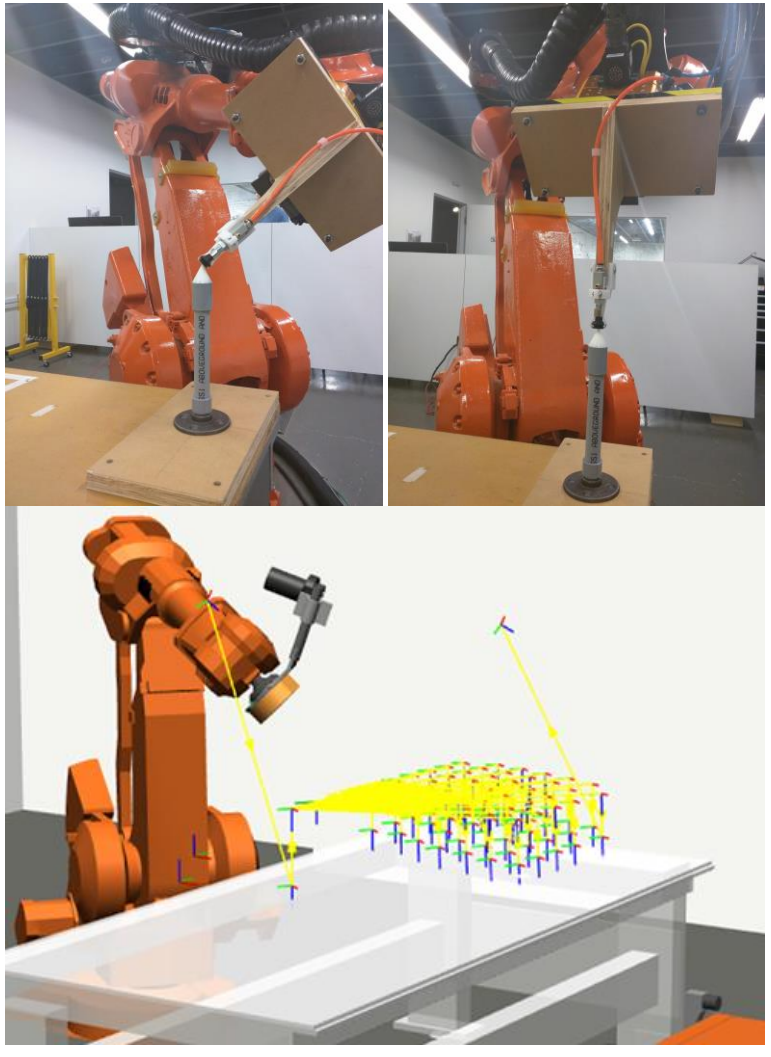
Shingle Preparation

- Process the prepared cut list
  - Generate file for laser cutting the shingles
  - Generate trajectories for the robot to prepare the shingles
- Modify shingle by engraving serial number and drilling holes as per our holder



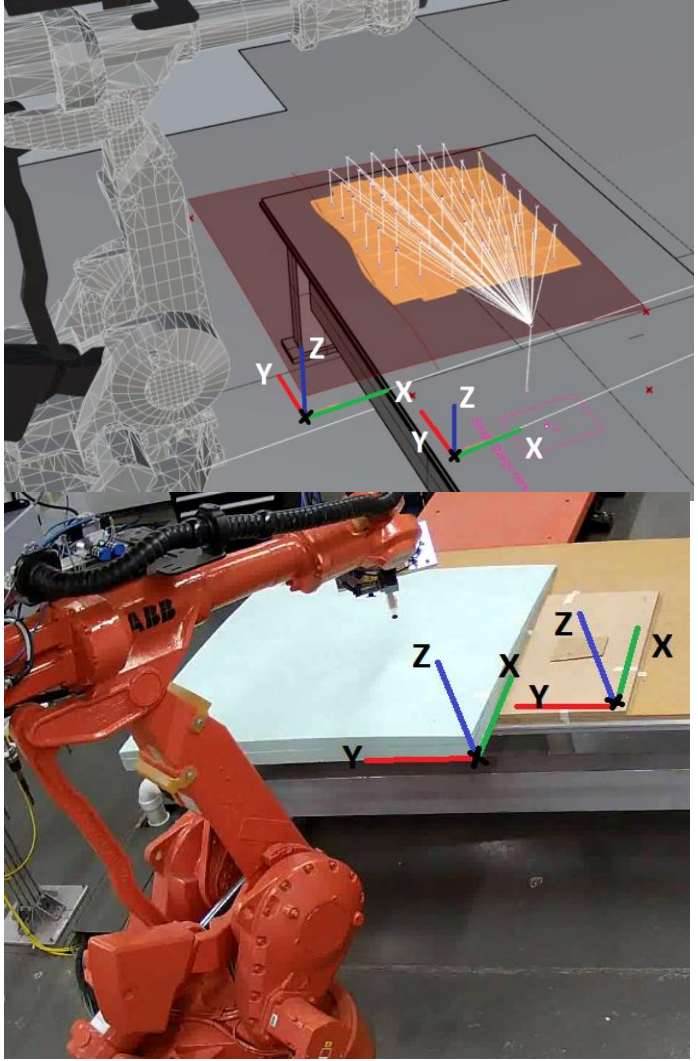
Trajectory Generation

- Plan approach towards the pick and place points
- Train the tool/end effector and the objects in the environment
- Configure modules for I/O ports to actuate the end effector



Work Object Definitions (Reference Objects)

- 2 reference frames (Foam Piece and Shingle Dispenser)
- Coordinate frame definition on software
- Association of trajectory points to reference frames
- Training robot and defining coordinate frames in robot frame
- Execution



Inputs

- Surface to be shingled
- Maximum Dimensions of a shingle
- Gap between shingles in the same row
- Overlap Between shingles from 2 different rows
- Pattern on the bottom of each row

Outputs

- List of shingles generated and their file (to be input in a laser cutter)
- Pick points
- Place points
- Nail Points
- Trajectory
- RAPID Code

Final Product - Video

https://www.youtube.com/watch?v=rDl49Gicg_g