RESEARCH OBJECTIVE

Incremental sheet forming (ISF) is a flexible metal forming process that allows users to form sheet metal parts with various geometries without using any geometric-specific tools. One critical consideration in ISF is to compensate for the springback error. This project focuses on using the photometric stereo-based 3D reconstruction of the geometry being formed to guide the real-time springback compensation.

**Proposed Framework**

- **Task 1:** ISF part images under different light conditions
- **Task 2:** Deep CNNs
- **Task 3:** Feedback

**Data-driven Reflectance Model of Aluminum**

Experimental setup

- $I = f(\theta_0, \theta_1, |\phi_0 - \phi_1|)$
- A neural network trained with 18,632,095 experimental data

**Error**

- Collimated Light: 0.302°
- Point Light: 0.252°

**Validation Result**

Actual normal maps VS predicted normal maps by DNN

- **Average error:**
  - 1.462°
  - 1.890°

**Future Work**

1. Reflectance model from experiment considering roughness
2. Implementation on ISF machine and forming experiment