

# Enhancing Validation of Vision Based Navigation Algorithms through Data Augmentation

## Introduction

- Active Debris Removal and In Orbit Servicing will require autonomous in-space Navigation that uses real time visual inputs (*Vision Based Navigation*).

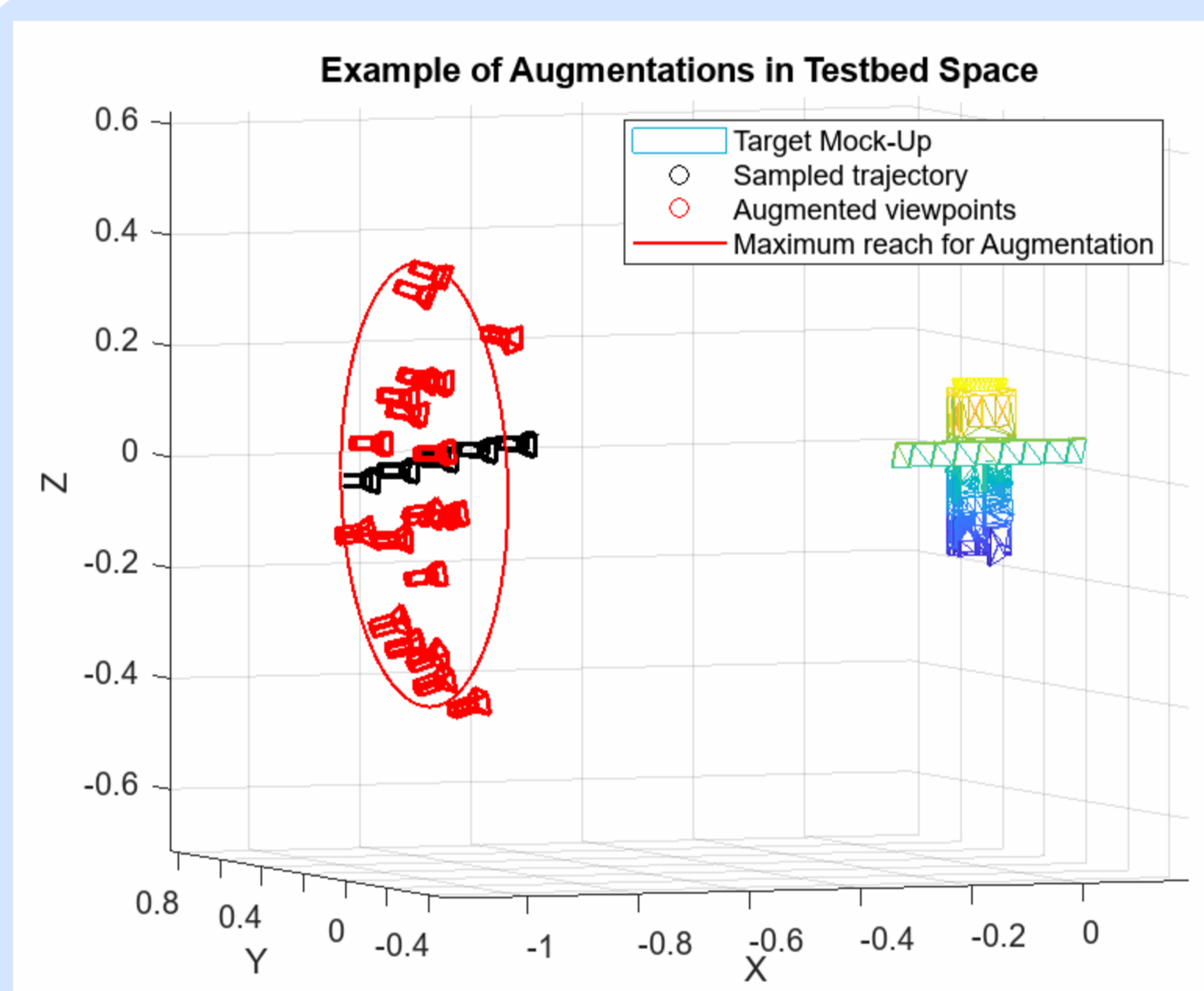
### Important questions:

- How to reliably validate the Image Processing algorithms on ground?
- How to create sufficiently large datasets for training and validation with limited resources?

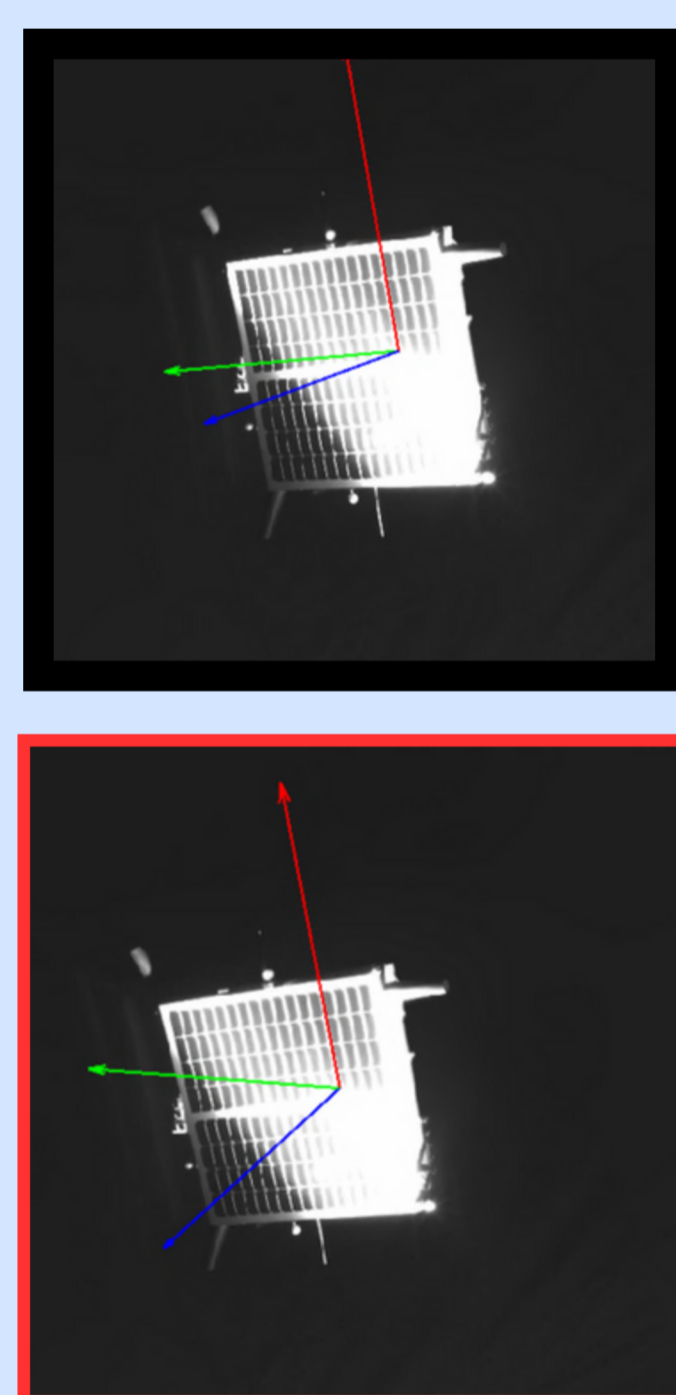
## Method

We propose augmenting existing datasets by transforming data into new viewpoints (*synthesis*). This reduces acquisition time (possible just in open loop) while retaining the benefits of each of the two image types.

The viewpoint synthesis relies on the relative pose between sensor and target from the ground truth while 3D models can be used to increase accuracy.



View from camera:



The maximum reach of the Transformation (red volume) is mainly limited by the magnitude of the relative rotation between the viewpoints.

## Results

Multiple types of transformation were implemented for the viewpoint synthesis. Simple 2D methods only require the relative pose but suffer from geometric inaccuracies, 3D methods that exploit the pixel-wise depths are more accurate but require more extensive ground truth.

In general new viewpoints that differ only in translation can be synthesized better than those with added rotation.



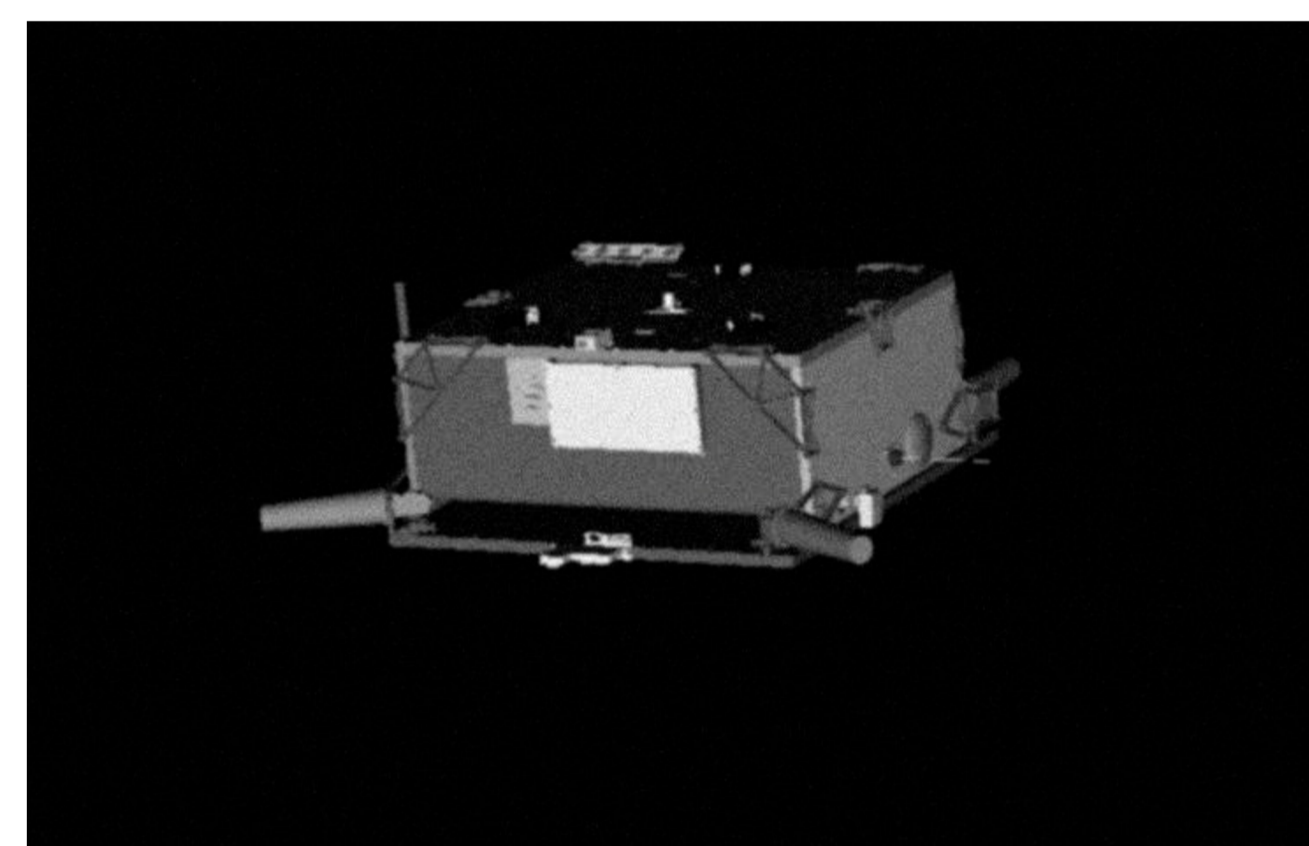
Image credit: OHB Sweden

### Types of Data for the Validation of IP algorithms

#### Orbital Imagery

- + Gold standard, most representative
- Rare, difficult to obtain

#### Alternatives:



#### Synthetic Imagery

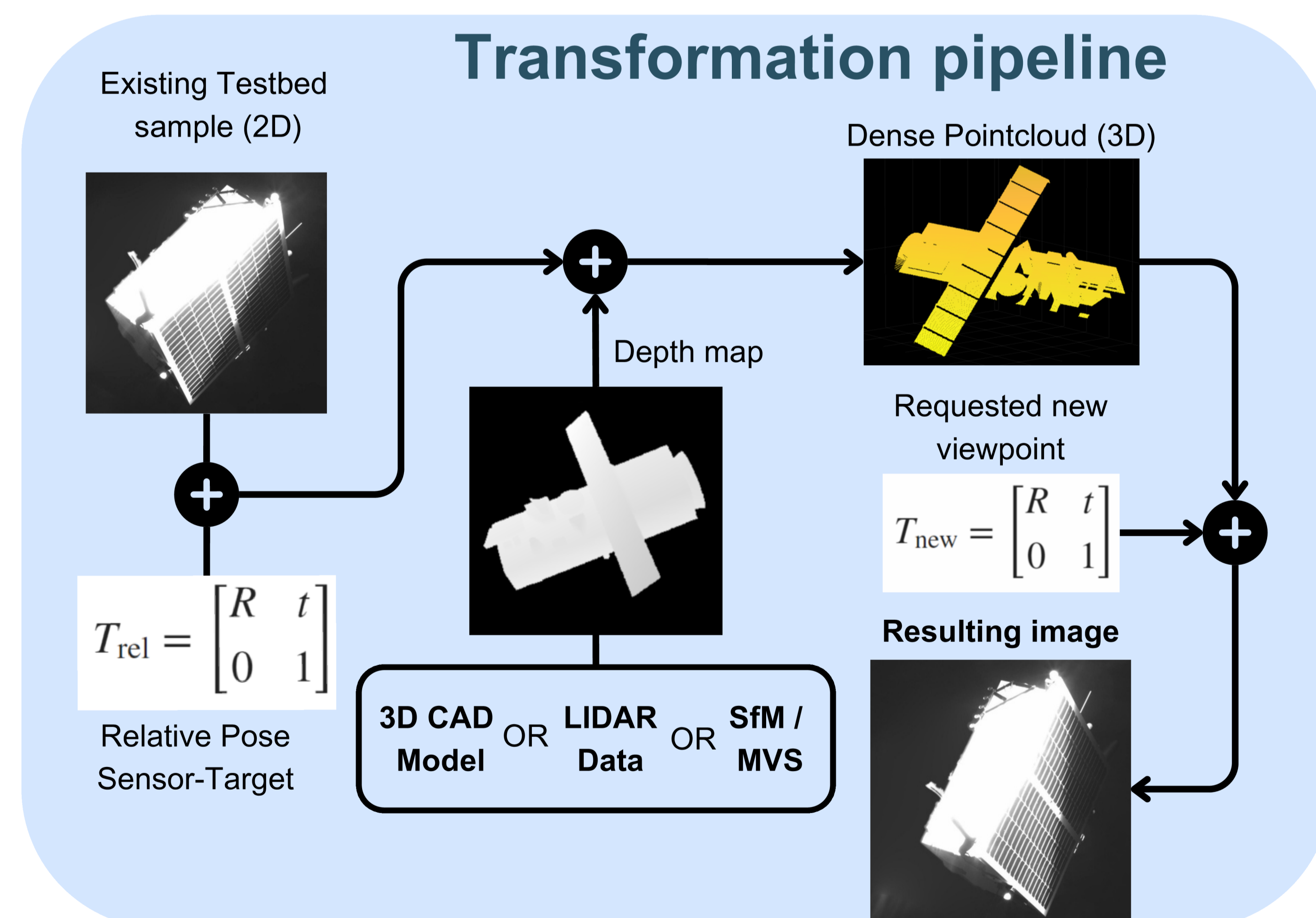
- + Very flexible, can create diverse scenarios
- Expensive to validate representative renderer
- Hard to recreate accurate surface properties
- **Computationally expensive to produce**



#### HIL / Robotic Testbed

- + Real visual sensor
- + Recreates accurate surface properties
- Accurate lighting conditions difficult
- **Expensive and time-consuming to set up**
- **Limited viewpoints**

Our work facilitates these points



## Next steps

Implementation of LIDAR data for depth map of unknown target use-case. Application to landing scenarios.

## References