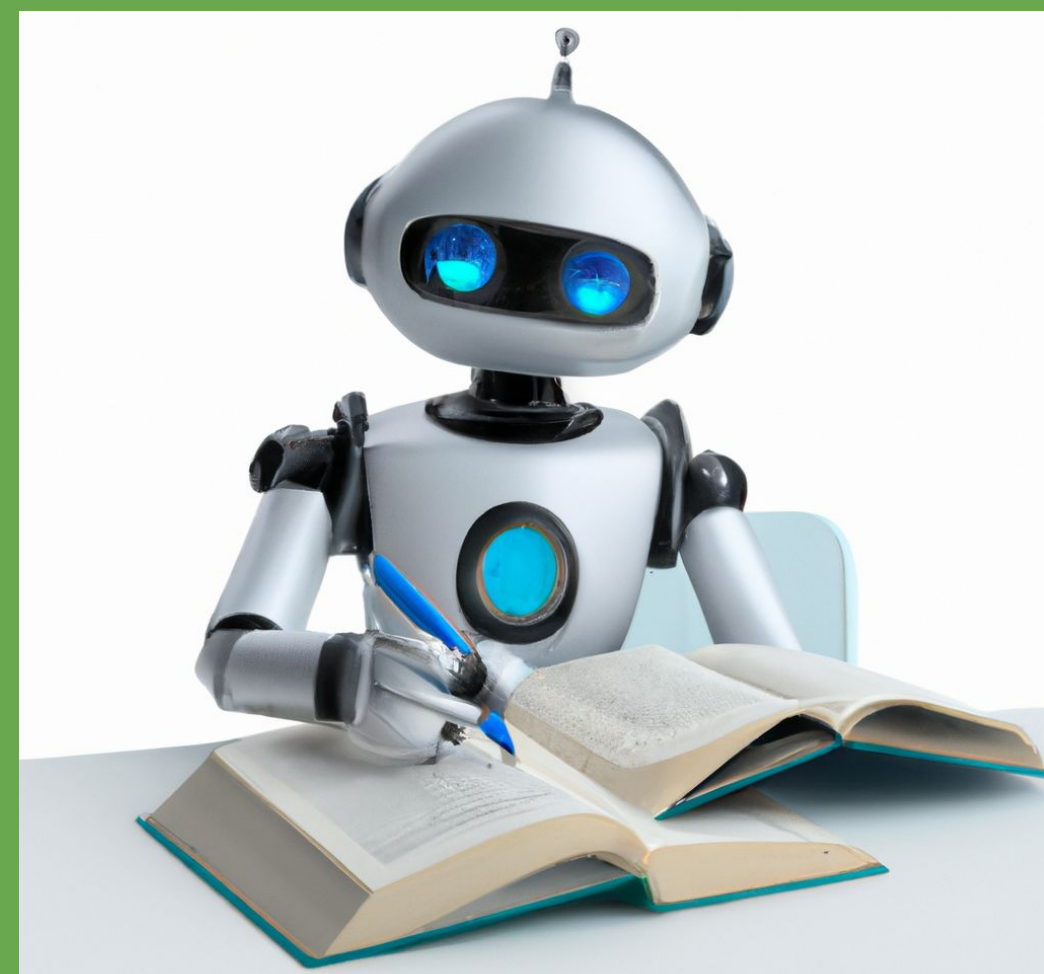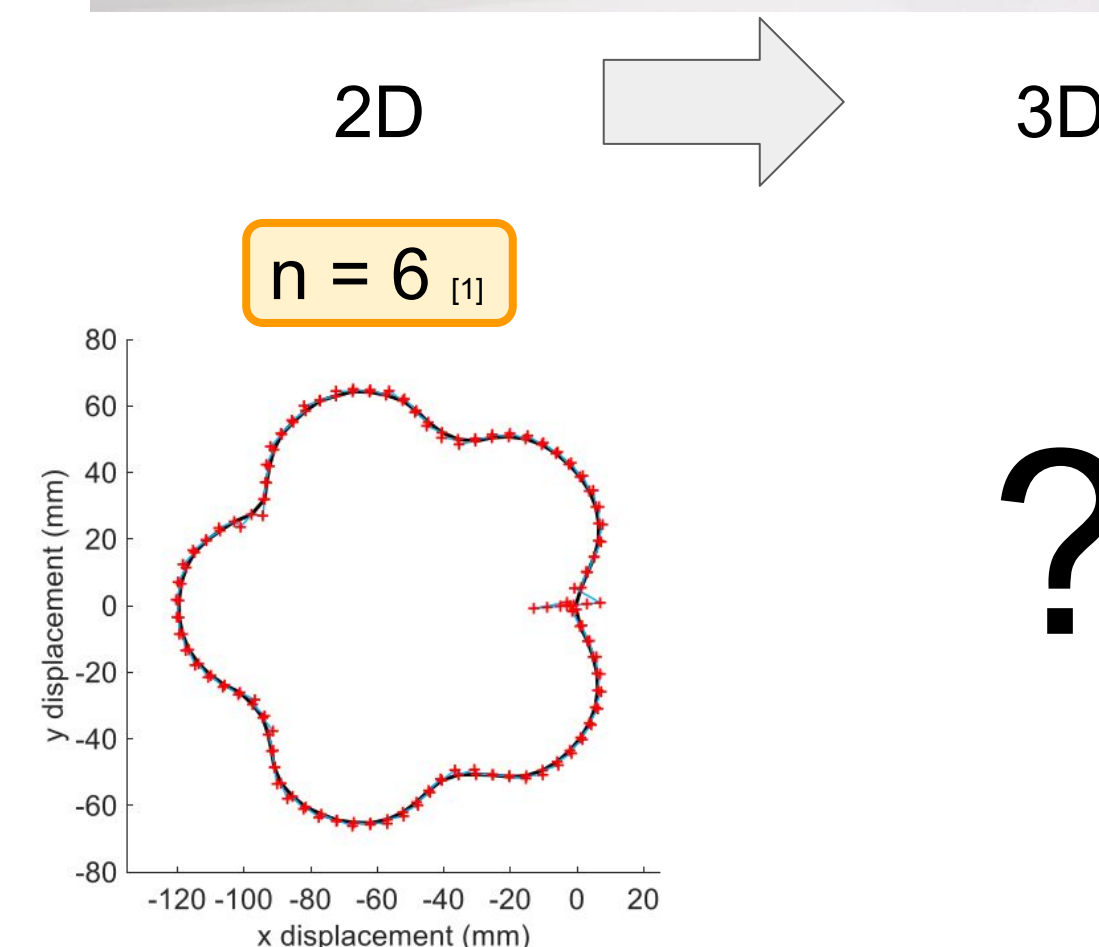# Continual learning makes tactile robots data-efficient, robust and adaptable

Elizabeth A. Stone, Nathan F. Lepora, David A.W. Barton
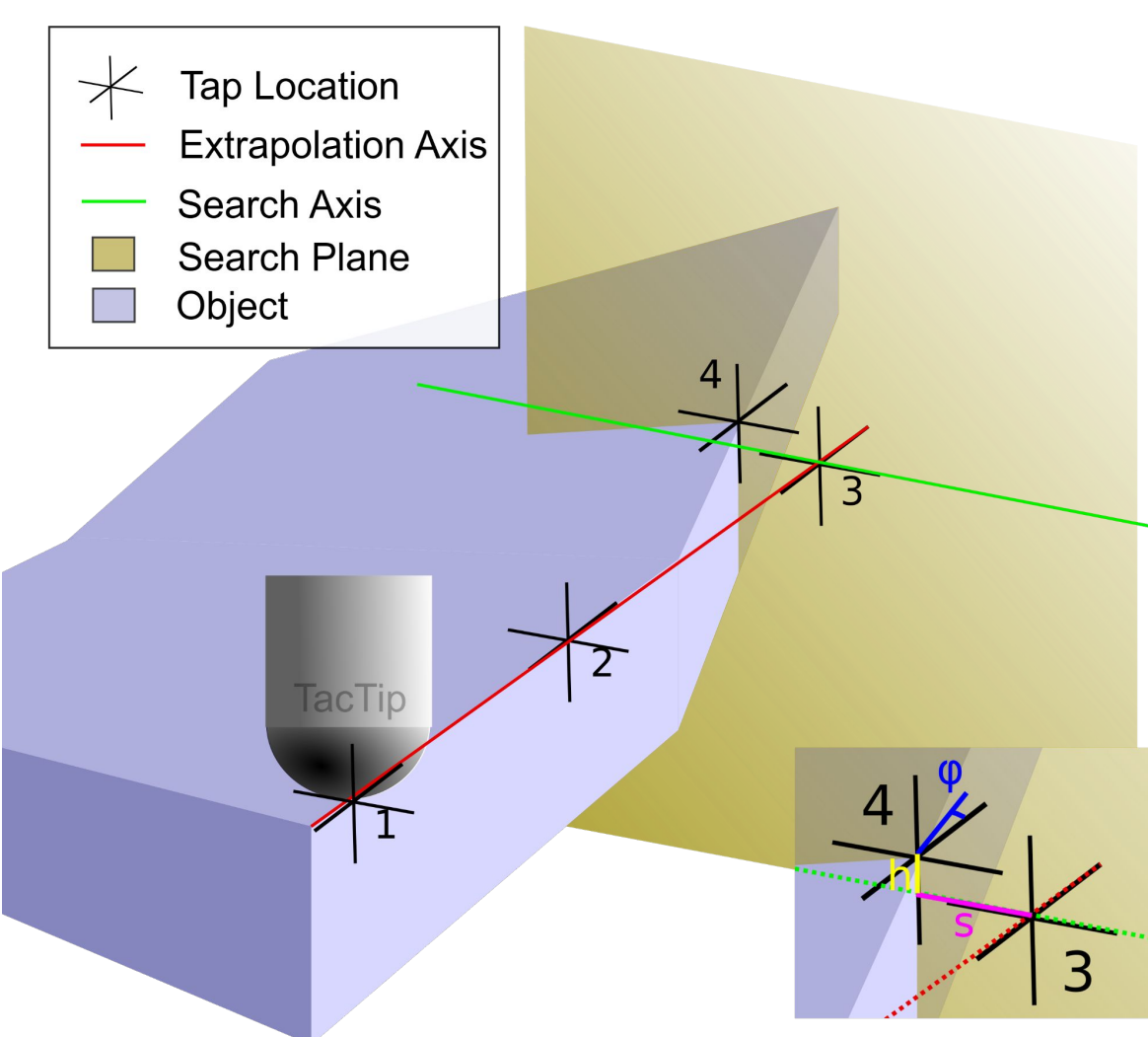
Task - 3D Edge Following

Following edges with varying heights, because the **real world** is 3D.

2D → 3D

n = 6 [1]

?

Can **data-efficient** 2D methods[1] be adapted to 3D?

Task Breakdown

Tap Location
Extrapolation Axis
Search Axis
Search Plane
Object

TacTip
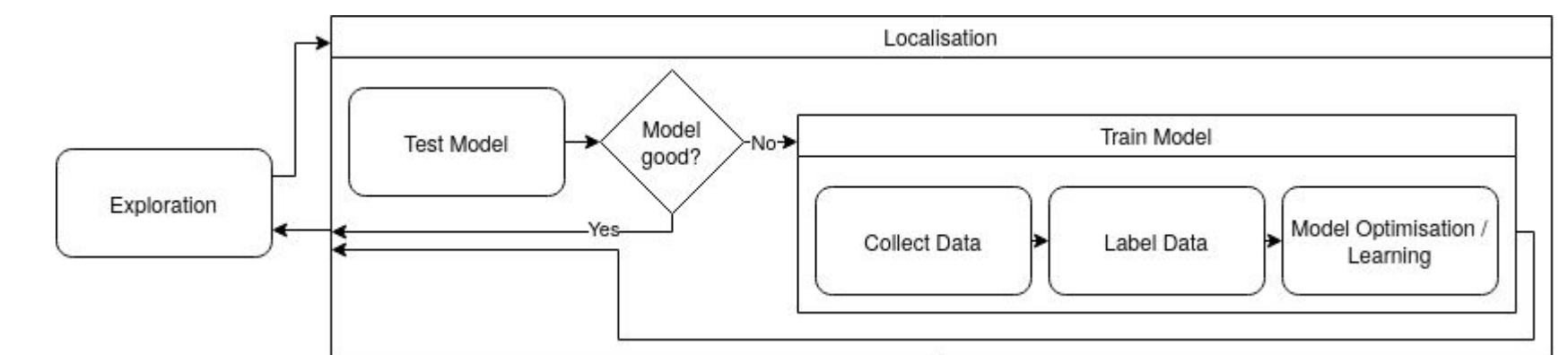
Find the edge in the Search Plane i.e. learn how to get from 3 to 4, for **any** value of s, h and φ.
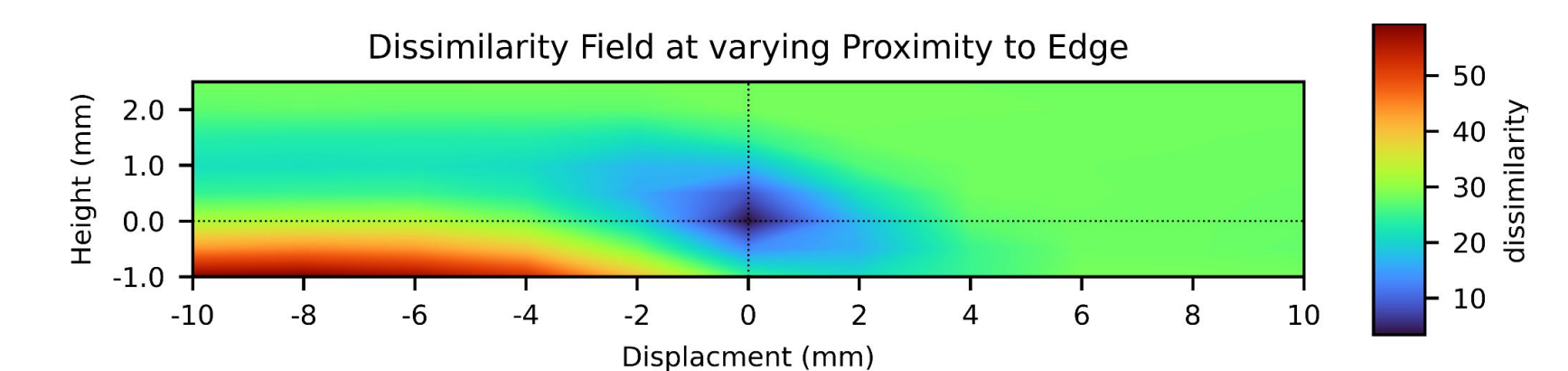
Online Learning Policy

Start with a tiny data-set and add data **only** when the model is not good, to make it better. Any data added is **relevant** to the task at hand.

Localisation · Exploration · Test Model · Model good? · No · Yes · Train Model · Collect Data · Label Data · Model Optimisation / Learning
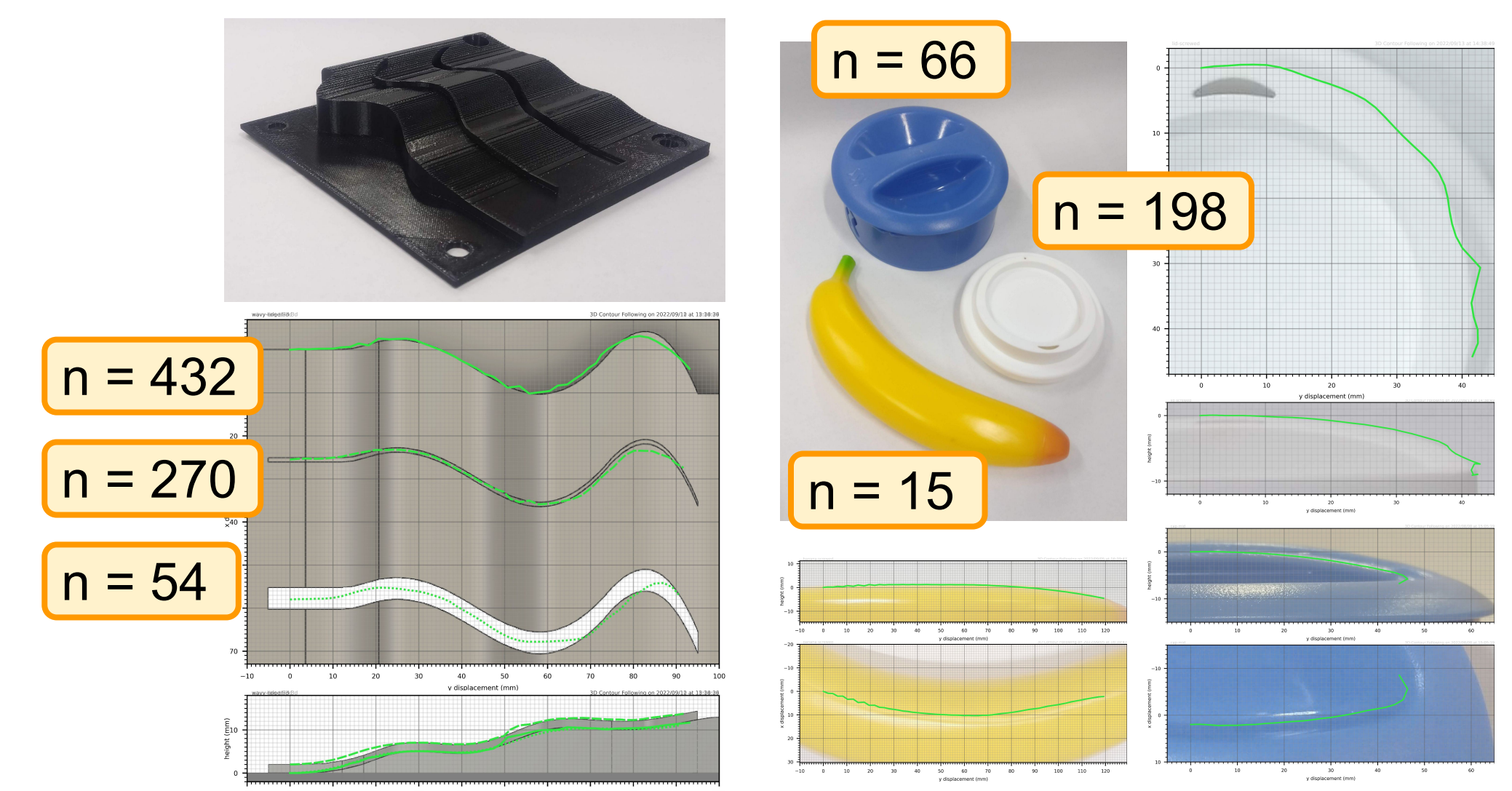
Automated Data Labelling

Collect data at various locations in the search plane, when needed, and label by **aligning** with a **reference datapoint** (which defines what an edge is).

Dissimilarity Field at varying Proximity to Edge

Results

When data is collected in a **full grid** pattern, **complex** and **everyday** 3D shapes are followed accurately.

n = 66
n = 198
n = 432
n = 270
n = 54
n = 15

[1] Stone, E. A., Lepora, N. F., & Barton, D. A. W. (2020). Learning to Live Life on the Edge: Online Learning for Data-Efficient Tactile Contour Following. *Intelligent Robots and Systems (IROS)*. https://arxiv.org/abs/1909.05808

n = number of datapoints in final model