maeve
AUTOMATION

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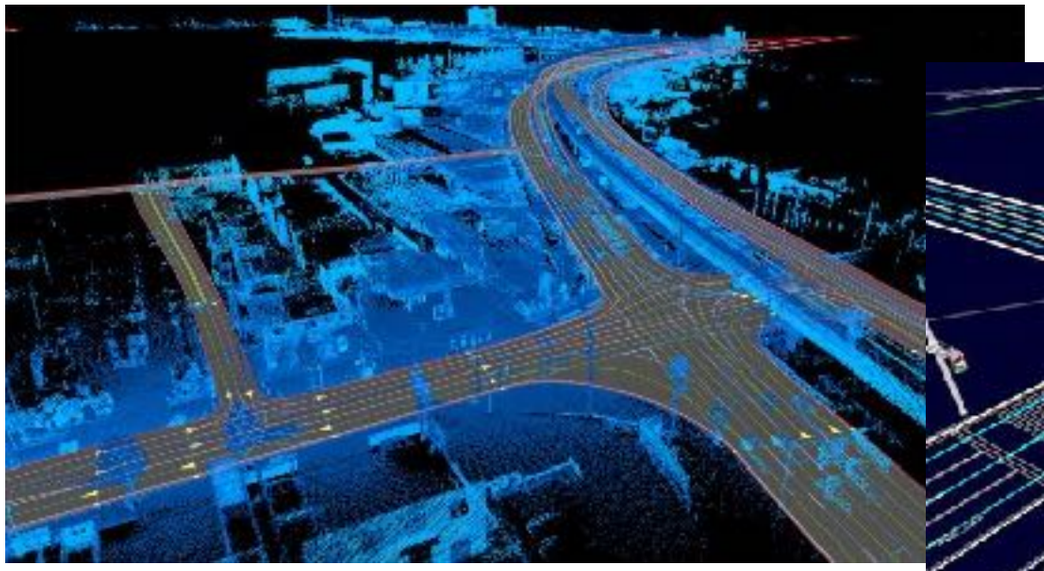
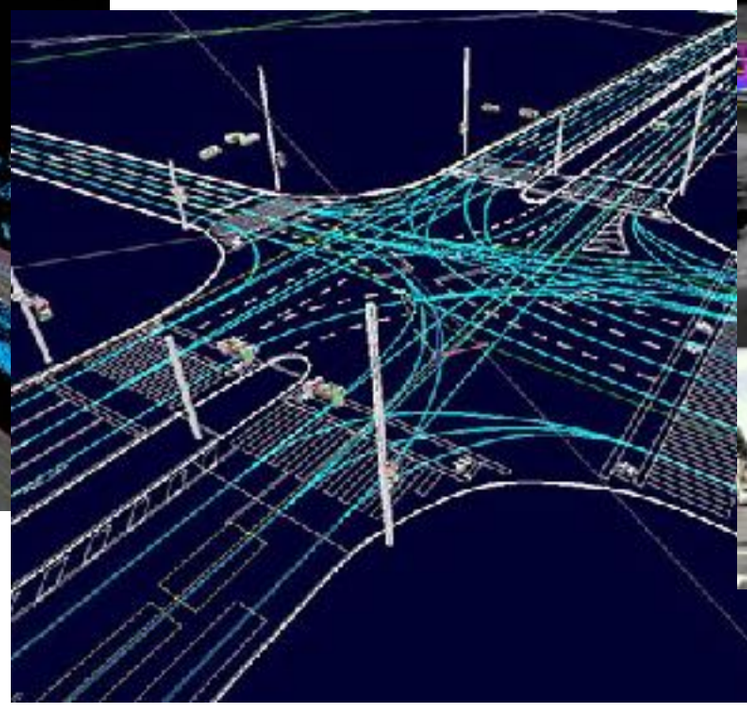
CONSTANT SPACE COMPLEXITY ENVIRONMENT REPRESENTATION FOR VISION-BASED NAVIGATION

NAVIGATING THE WORLD



Nokia/Here

Zenrin



Google/Waymo

From a navigation standpoint, modeling the world explicitly in 3D has intuitive appeal

But the world is large and uncertain, which causes problems using with these models

THE COMPLEXITY PROBLEM

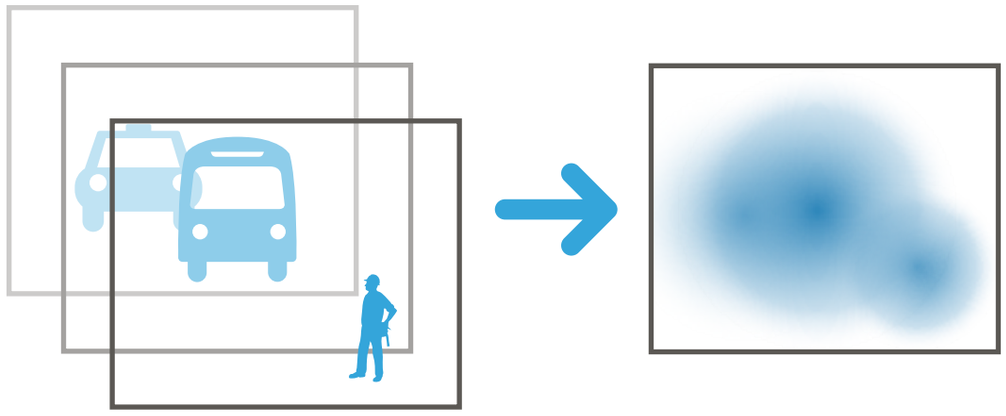
Many traditional approaches to control and planning scale in the number of objects in a scene

In practical situations such scaling often quickly become problematic

THE REPRESENTATION PROBLEM

- Typical approaches will want position and velocity estimations for all of these vehicles in Euclidean 3-space
- Sensor limitations can lead to poor quality estimates in this space
- State estimation in image space, however, can be much more accurate

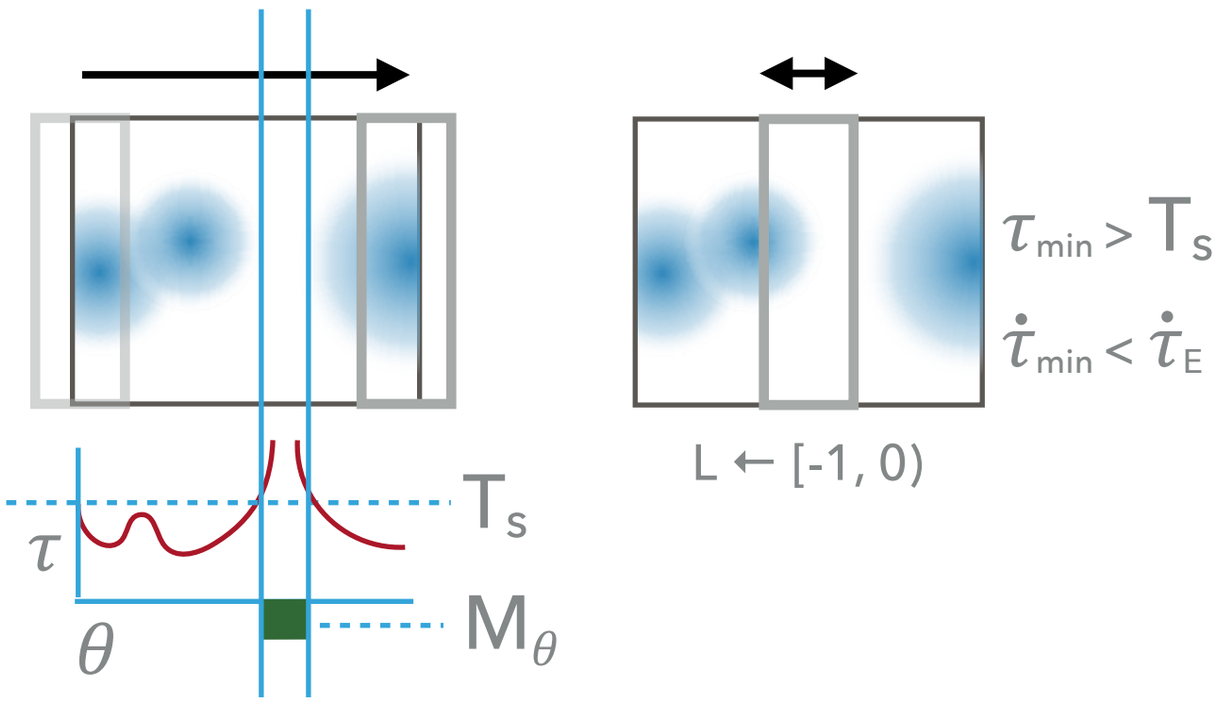
IMAGE SPACE POTENTIAL FIELDS



$$F(x,y) = \left\{ \min_{\tau} \left(F_1(x,y), F_2(x,y) \right) \mid (x,y) \in I \right\}$$

Left: Perception and tracking in the image plane output multiple objects

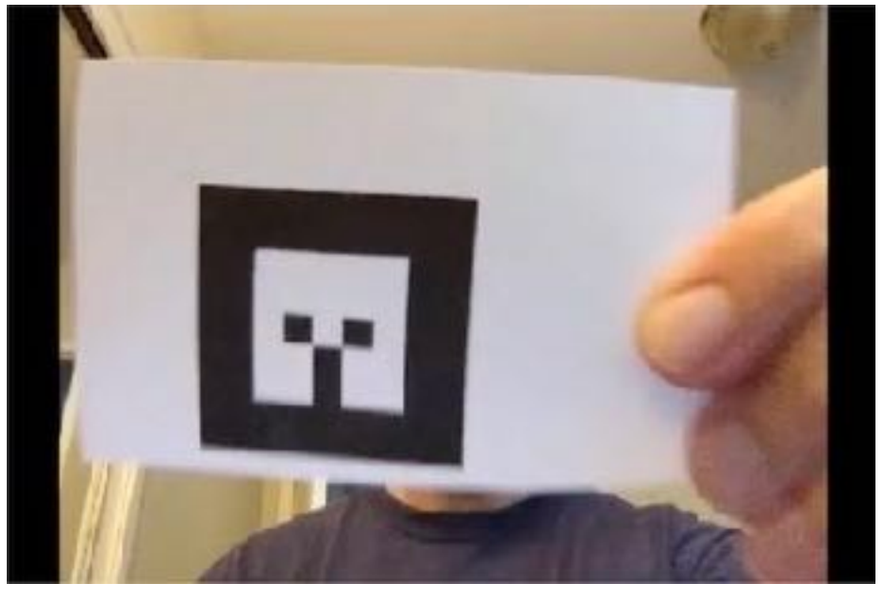
Right: The potential field collapses these objects to a fixed-size representation

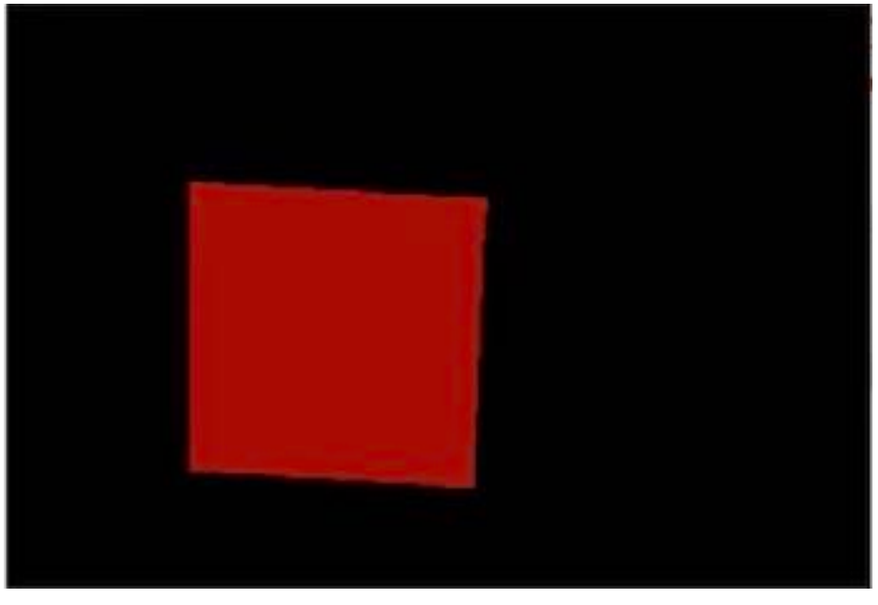


Left: Directional control can be determined by a convolution of the ISP

Right: Longitudinal control can be determined similarly

IMAGE SPACE POTENTIAL FIELDS





FUTURE WORK

- Generalize potential fields to unitless measure
  - Enable meaningful fusion of information from multiple sources
- Coupled control law
  - Enable more natural, intuitive behavior
- Work underway at: https://maeveautomation.com/development/