

Lecture 23, Mar 9, 2026

Introduction to Localization and Mapping

- Navigation at sea before GPS was accomplished using a sextant to measure latitude based on celestial observations, and an accurate clock to determine longitude
 - The Mariner's compass allowed navigation along a rhumb line (constant bearing)
- Early map making relied on triangulation using bearings to landmark points
 - One known distance was needed to determine scale
 - Angle measurements using instruments such as the backstaff, quadrant, and theodolite in increasing accuracy
- Arctic mapping was more challenging since stars aren't visible in the summer and the sun isn't visible in the winter, and most terrain was featureless
- Photogrammetry in the 1920s improved accuracy greatly using aerial photos
 - Dr. Deville perfected oblique aerial photography for surveying, making Canada a leader in this field
 - Originally stitching of images had to be done manually, and later through bundle adjustment with manually identified features
- Types of maps by application:
 - Planning map: keeps track of occupancy, safe and unsafe places
 - Application map: keeps track of spatially distributed properties, e.g. temperature, signals, topography
 - Navigation map: used for localization and mapping, sometimes sparse (e.g. feature-based)
- Types of map by information contained:
 - Metric maps: retains the notion distance (i.e. scale) between all points; everything is metrically consistent
 - Topometric maps: locally metric, interconnected globally (e.g. mapping individual rooms metrically and connecting rooms topologically)
 - Topological maps: retains only the interconnectedness of places without accurate distances