Possible CS428 Class Projects

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Project Types

- Design and implementation, using available networked iPAQs
  - 6 using Linux
  - 4 using Windows CE with NexiCam Cameras
  - Laser range finder also available to help with iPAQ localization
  - Time synchronization of iPAQs to better than 100ms seems difficult
- Sensor net algorithm design, validated using simulation
- Sensor net algorithms design, with theoretical performance analysis
Routing: Hole Discovery

- Discover *holes*: areas of the network where greedy geographic routing algorithms will fail
- Mark the nodes on the boundary of these holes
- Study strategies for routing around such holes
Routing: Path Migration and Improvement

- Study local methods for improving paths (path homotopy)
- Maintain good paths, as endpoints move (local heuristics)
- How can we discover that a path can be improved by jumping over a hole?
Computing Minimum Exposure Paths

- Given a sensor field, evaluate paths through the field that minimize target exposure.
- Find sensor placements that maximize the minimum target exposure.
Counting Targets in a Region

- Efficiently determine the number of targets present in a given region
- What can you store to optimize the performance of repeated queries of the same type, but with different parameters?
Optimal Evaluation of CCW Relations

CCW\((a,b,c)\) asserts that the triangle defined by \(a\), \(b\), and \(c\) is counterclockwise oriented.

CCW predicates can capture the notion of the convex hull of a set of points, the notion of inclusion in a convex polygon or triangle, and many other spatial predicates.

For CCW\((t1,t2,t3)\), \(s2\) is more valuable than \(s1\).
Evaluating the “Am I Surrounded” Relation

Say the white vehicle is surrounded by the black vehicles, if it is inside the convex hull of those vehicles.

Can we decide this predicate without localizing all black vehicles? In general very few black vehicles should suffice (3).
Tracking the “Surrounded” Relation

- When the white vehicle escapes the surrounding triangle, the sensor net searches for a new black vehicle that can still establish containment.
- What are good strategies for finding such a new vehicle (pivoting step)?
Tracking a Shadow over a Sensor Field

- How can we best track the position and orientation of a shape moving over a fixed sensor field?
- Which sensors need to be active when?
- What if some sensors could move to help better estimate the shape?
Localization Using Total Least Squares

- Use combination of distance (amplitude) and bearing (DoA) sensors
- Quantify the errors introduced by different sensor mixtures and placements
iPAQ Localization in Gates

- Use base base station IDs and wireless signal signatures
- Assume map of building is given
- Construct topological building map, using similarity measures on signatures
Leader-to-Leader Handoff

- Restrict each iPAQ to talk only to a few neighbors
- As in the warm up project, the iPAQ hearing the loudest target signal is to be elected leader
- However, to save power, the current leader *alerts only a small number of neighbors to participate in the next leader election*
Multicamera Tracking

- Use the camera equipped iPAQs to track a moving object in a large space; assume iPAQ positions are known.
- A subset of the camera iPAQs transmit images to a central computer where background subtraction and silhouettes intersection is used to localize the object.
- Different subsets of the iPAQs need to be selected for this computation, depending on the location of the object.
Project Deadlines

- Project proposal due in class, on Thursday, May 1, 2003
- Final project due in class, on Thursday, May 29, 2003