

The radio beacon based method described here provides a highly effective swarm navigation scheme that is of low complexity, robust, and highly scalable. Rather than using a few highly complex and expensive swarm agents to complete a mission, we at EasySen (www.easysen.com) believe in the advantages of large ultra-low complexity swarms that solve problems reliably through emergent behavior.

The Concept

We propose the use of radio frequency beacons to generate (switched) potential fields for navigation of large numbers of swarm agents. The idea is to use attractive beacons as waypoints and local attractors. Repelling beacons on each agent and waypoint are used to control the density of agents and avoid collisions. If a certain sequence of waypoints defines a navigation path, then the attractive beacons need to be distinguishable and need to be visited in a certain sequence. (This is easily implemented in form of a finite state machine in each sensor swarm agent.) Repelling beacons are local and do not need to be distinguishable. Individual sensor swarm agents are equipped with a side-looking stereo receiver with opposite directions of highest sensitivity. A simple difference between the left and the right Receive Signal Strength Intensity (RSSI) allows to detect in which half space (relative to the center length axis of the vehicle) a beacon is located. One can then navigate towards a beacon by always moving towards the receiver side that has produced the stronger RSSI reading. For repelling beacons, one always moves towards the direction of the smaller RSSI signal.

The applications of this paradigm are many and range from environmental clean-up such as oil spill removal to surveillance and protection tasks. A ground vehicle swarm that performs a simple detection task based on this principle is shown on Youtube at <http://www.youtube.com/watch?v=D0Rgf-cKpV8>.

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Swarm Agents

