1. Introduction

- **Project Objective:** To design an efficient, scalable geographic routing protocol in wireless sensor network which can significantly shorten the hop-to-hop routing path and be scalable under different network topologies and node densities.

2. Motivation

- **EGFP is motivated by GPSR (Greedy Perimeter Stateless Routing)**
- **GPSR exploits the duality between greedy routing and face routing**
- **In face routing, GPSR exclusively takes counter-clockwise direction in selecting next hops, which is not always a good choice.**

3. Related work and underlying Architectures

Almost every geographic routing algorithm operates on planarization. Without planarization, face routing will fail even in the most simple topologies.

- **Common planarization strategies are Unit Disk Graph (UDG), Gabriel Graph (GG) and Relative Neighbor Graph (RNG).**
- **EGFP implements both Gabriel Graph and Relative Neighbor Graph as planarization strategies.**

4. Algorithms

### Part One: Face Probing

- **Before probing:**
  - After initialization, every node has default direction as CCW and midway as null.
  - Only local minimal needs to send probe packets, because Greedy forwarding only fails at local minimal nodes and alternative routing strategies has to be used.

- **Probing package header**

<table>
<thead>
<tr>
<th>Field</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>curr_hop</td>
<td>Hop count so far</td>
</tr>
<tr>
<td>exitpt</td>
<td>The closest node to destination</td>
</tr>
<tr>
<td>ccw_hop</td>
<td>Counterclockwise hop count to exitpt</td>
</tr>
</tbody>
</table>

### Part Two: Data Packet Routing

- **Under Directional mode, data packet is forwarded using GPSR face routing rules, edge selection direction is determined by direction field in data packet unless forwarding node is midway node or data packet exits Directional mode.**
- **When data packet reached midway node, midway node writes data packet’s direction field with its own direction and update packet’s midway node.**

5. Performance Evaluation and Future work

Performance is evaluated in terms of Path Stretch Factor, Number of local minimal and Total overhead

- **Path Stretch Factor** is the ratio of routing path length to shortest path length.
- **As observed figure on the left, EGFP has smaller path stretch factor than GPSR at all times, which means EGFP is significantly more efficient than GPSR in term of hop-to-hop routing path length in any node densities.**

- **Number of local minimal**

- **Total Overhead**

EGFP is also proven to be a scalable geographic routing protocol. As we can observe in the above two figures, both number of local minimal nodes and total overhead do not increase accordingly when the total number of nodes in the network increases.