An Information Model for Geographic Greedy Forwarding in Wireless Ad-Hoc Sensor Networks

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Outline

- Introduction
- Our Approaches
- Experimental Results
- Conclusion
- Future Work
Goal

- An efficient path in wireless ad-hoc sensor networks (WASNs)
  - Fewer hops and detours
  - Faster data delivery
  - More energy conserved
Problem

- Local minimum phenomenon (void)
  - Sparse deployment
  - Physical obstacles
  - Node failures
  - Communication jamming
  - Power exhaustion
  - Animus interference
Idea

- Information helps routing to:
  - Predict the ‘void’ ahead
  - Make a slight turn early to sufficiently avoid being blocked
    - Non-detour routing, i.e., greedy forwarding without perimeter routing
  - Make a turn only if necessary
    - To keep the optimality of a straight forwarding
Challenge 1

- Identification of the **affected area** of a void
  - Relative to the positions of the source and the destination

Case 1

Case 2
Challenge 2

- **Mutual impact** of void areas
  - *Global* optimization achieved by *neighborhood optimizations*
    - No routing table, flooding, or broadcasting
    - Routing decision at each intermediate node
    - Neighbor information collection and distribution

![Diagram of source, destination, and area of mutual impact]
Challenge 3

- **Unstructured WASNs**
  - Hard to ensure whether the forwarding still achievable **ahead**
What kind of information and how to conduct a forecast?

West Chester (source)

New York (destination)

No global information

Information exchanged with next light

light control related to travel destination

traffic prediction
Related Work

- “Dead end” model
  - No optimization

- Boundary model
  - No global optimization

- Hull algorithm, or turning angle model
  - No consideration of the relative positions
Our Approaches

- Tradeoff between routing adaptivity and structure regularity
- Safety information for such a forwarding
- Information based forwarding (SLGF routing)
Tradeoff

- A forwarding with infrastructure in WASNs
  - LAR2:
    - Forwarding to a neighbor that is closer to the destination
  - We adopt LAR1
    - Forwarding limited in the so-called request zone
Safety Information

- Inspired by the safety model in 2-D mesh networks

- An unsafe area contains nodes that definitely causing routing detour.

- Constructed by a labeling process via information exchanges among neighbors.
Details of the Labeling Process

- **Unsafe node**
  - A node without any neighbor in the request zone
  - A node without any safe neighbor in the request zone

- **Unsafe area**
  - Connected unsafe nodes
  - Estimated as a rectangle at an unsafe node.

- **4 Different types of unsafe status**
  - Due to 4 different types of request zones
An Example of Type-I Safety Information

(a) unsafe status
(b) unsafe area and its estimation
(c) info. for mutual impact
SLGF Routing

- Four phases conducted in the order
  - Enforced forwarding
  - Safe forwarding
  - Perimeter routing (for making a slight turn)
  - Retreating (in the opposite direction)
Simulation

To verify whether

LAR1(-) + Safety Info. (-) + Info. based routing (+)

is better than boundary info. based routing.

Forwarding routings

- GF (LAR2 + boundary information)
- LGF (LAR1)
- SLGF (LAR1 + safety information)
Result Summary

- Cost
  safety information < boundary information

- Routing success
  GF = LGF = SLGF

- Routing path
  LGF < GF << SLGF
Conclusion

- **Unicast** routing but **neighborcast** information construction
- **Tradeoff** between routing adaptivity and information model cost
- **Mutual impact** of void areas
- Better forwarding routing to achieve more **straight** paths
Future Work

- **New** balance point of the tradeoff between routing adaptivity and information model cost
- **More** accurate information
- **Better** forwarding routing to achieve more straight path
Questions?

Thank you!