A COLREGs-Compliant Local Guidance System for Unmanned Surface Vehicles based on Hierarchical Task Network

Automated Planning

Darlan Alves Jurak

Unmanned Surface Vehicles

Unmanned Surface Vehicles

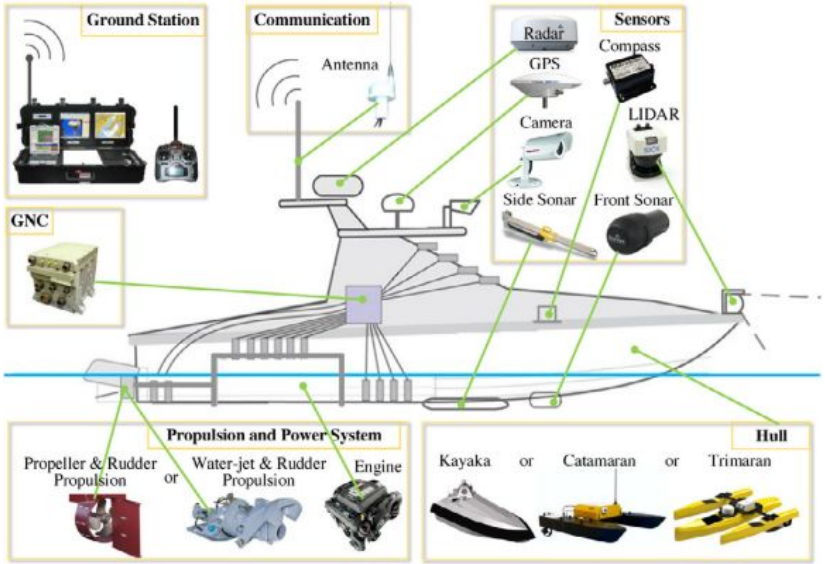


Fig. 1. Fundamental architecture of a typical USV.

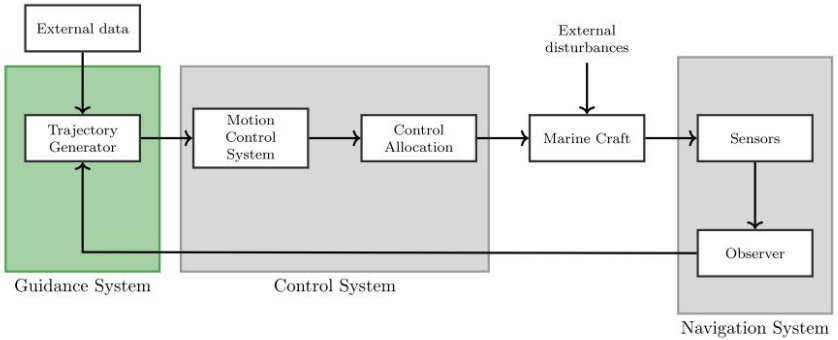


Figure 3.1: GNC system.

Unmanned Surface Vehicles

- Global / Deliberative
- Local / Reactive

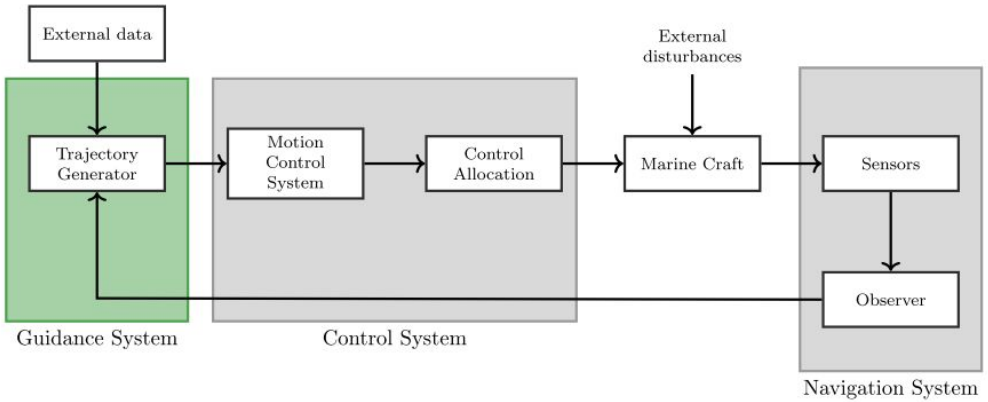
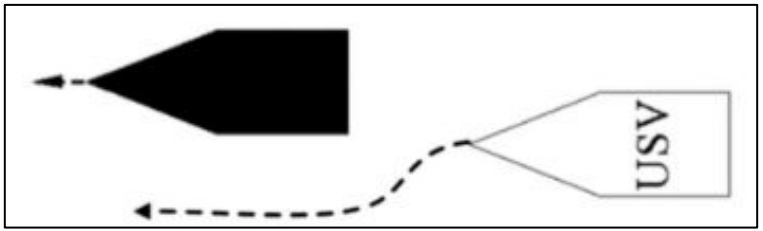


Figure 3.1: GNC system.

COLREGs

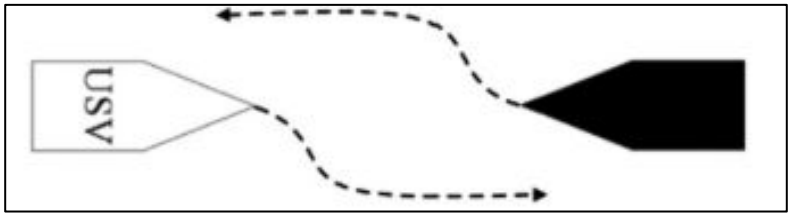
- Rules **13**, 14, 15, 16, 17



Overtaking

COLREGs

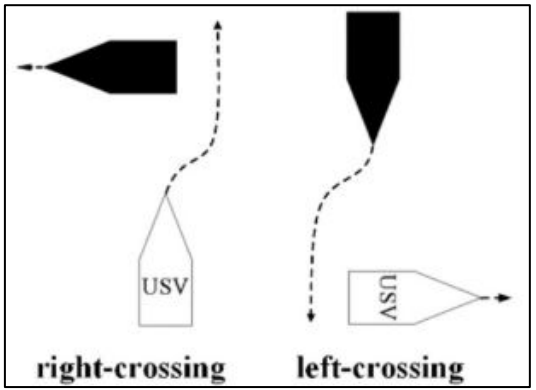
- Rules 13, **14**, 15, 16, 17



Head-on

COLREGs

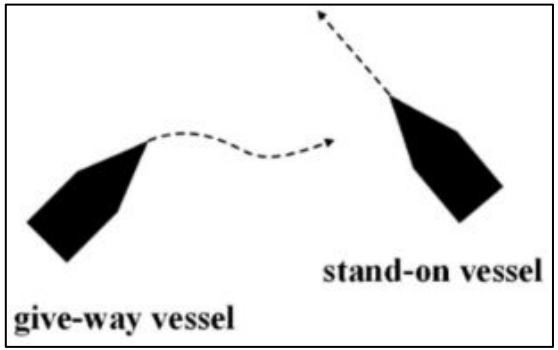
- Rules 13, 14, **15**, 16, 17



Crossing

COLREGs

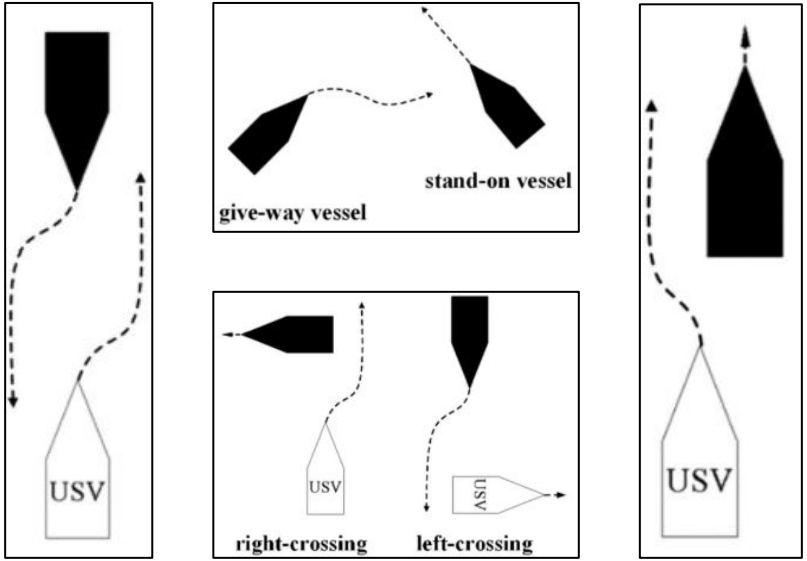
- Rules 13, 14, 15, **16**, **17**



Giveway and Stand-on

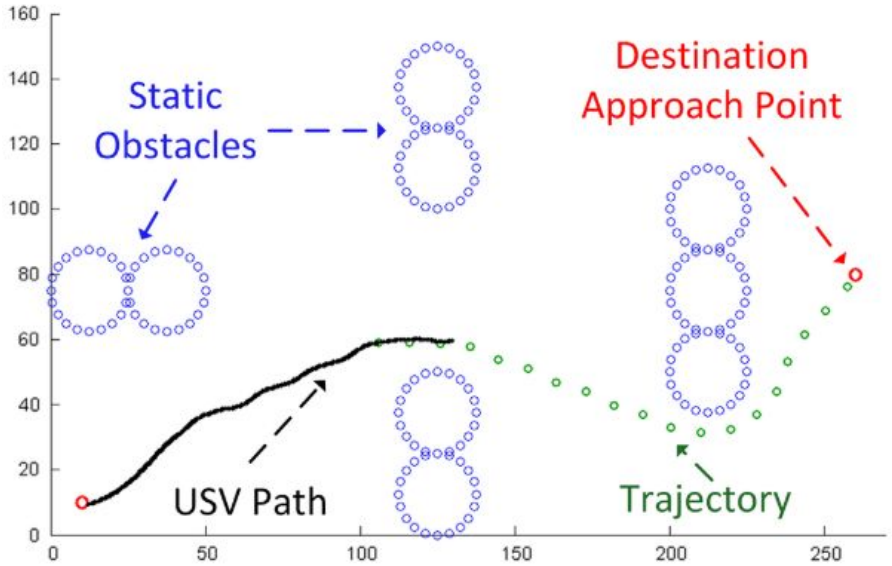
COLREGs

- Ambiguous



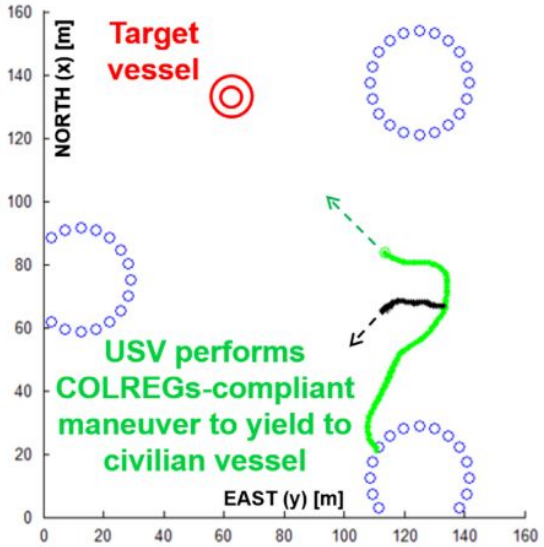
Related Work

- Path Planning



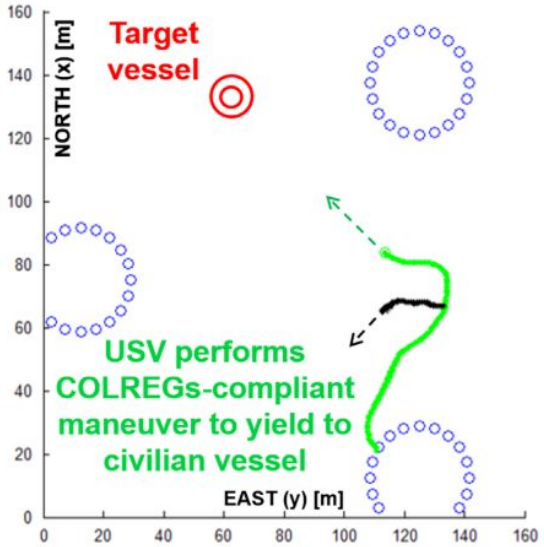
Related Work

- Path Planning



Related Work

- Path Planning
- USV Fleets



Proposed Work

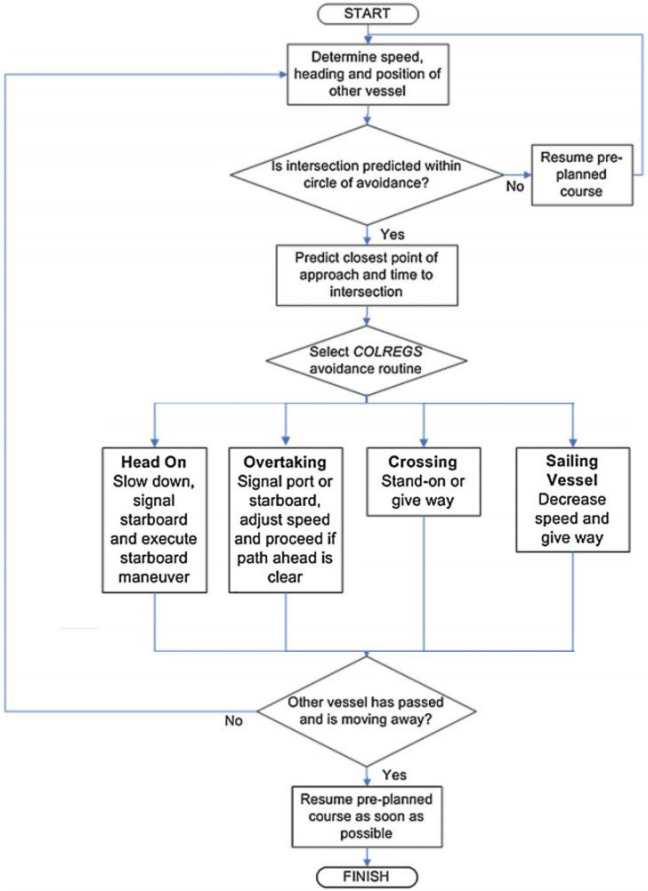
- Local guidance system
- Flowchart
- Danger zone
- COLREGs rule selection
- Trajectory commands
- Hierarch
- HTN
- Problem Constraints

Proposed Work

- Local guidance system

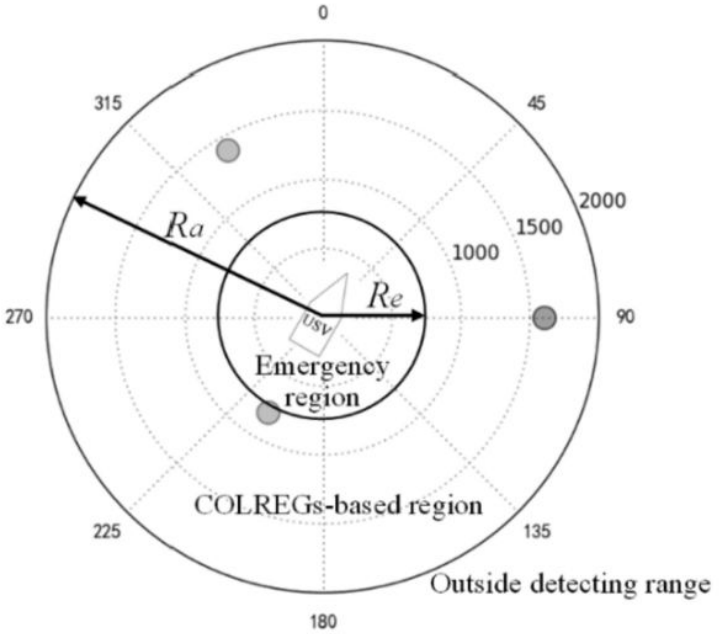
Proposed Work

- Local guidance system
- **Flowchart**



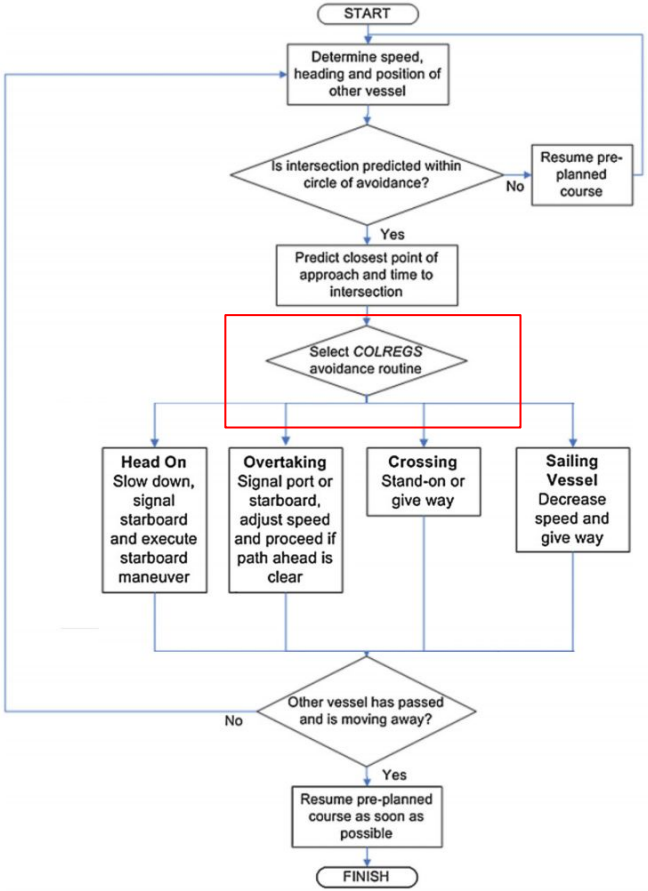
Proposed Work

- Local guidance system
- Flowchart
- **Danger zone**



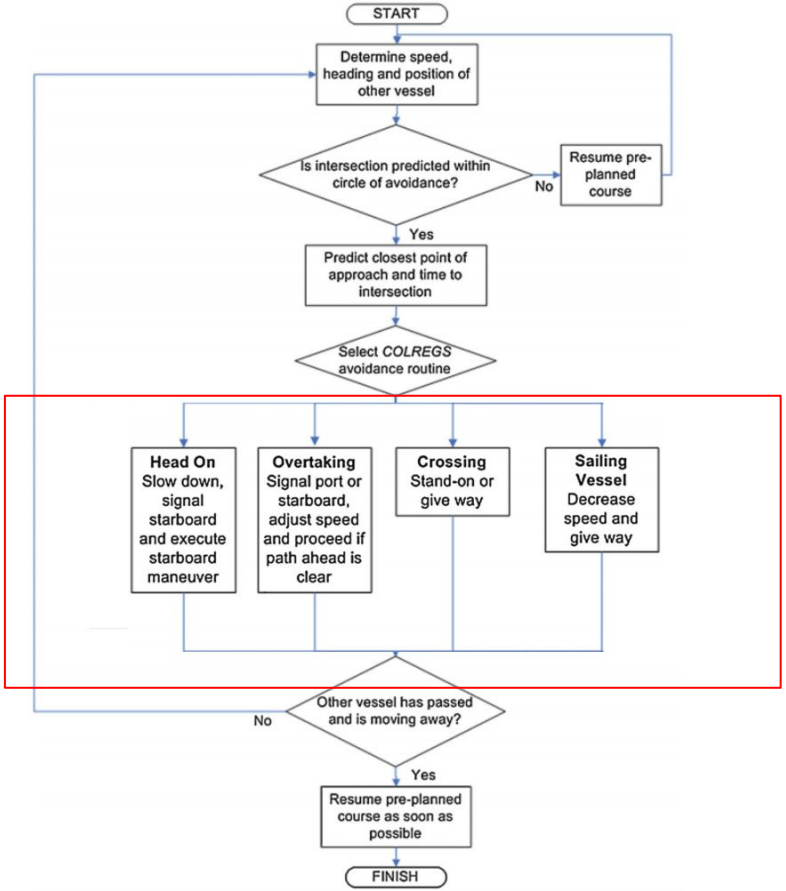
Proposed Work

- Local guidance system
- Flowchart
- Danger zone
- **COLREGs rule selection**



Proposed Work

- Local guidance system
- Flowchart
- Danger zone
- COLREGs rule selection
- **Trajectory commands**



Proposed Work

- Local guidance system
- Flowchart
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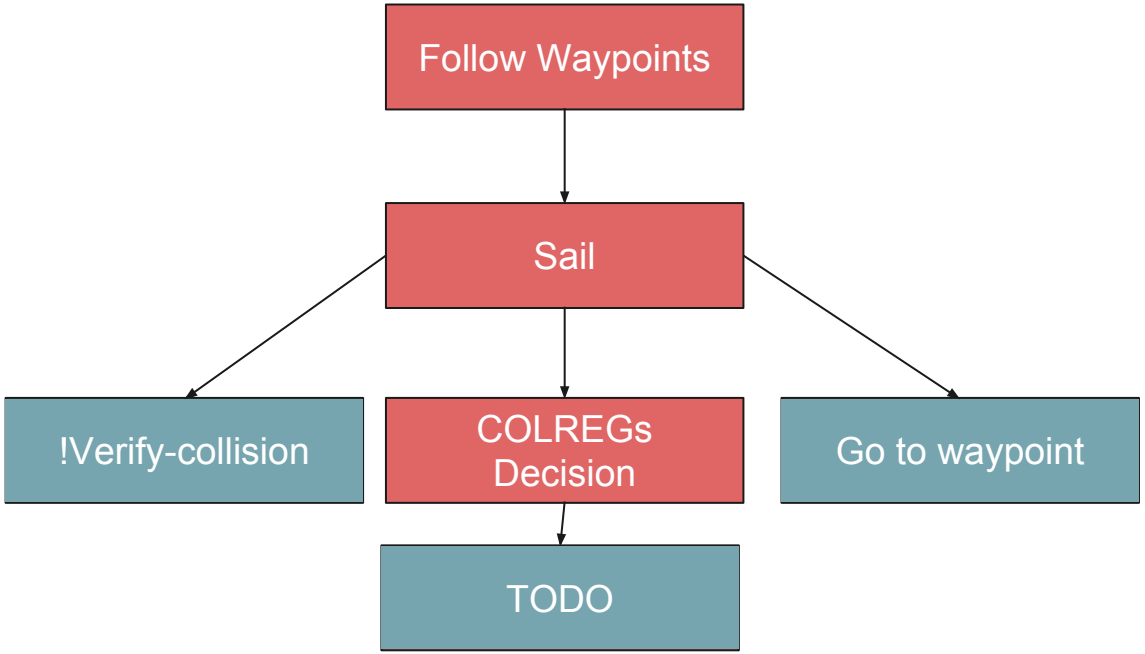
- COLREGs rule selection
- Trajectory commands
- **Hierarch**
- **HTN**



Proposed Work

- Local guidance system
- Flowchart
- Danger zone
- COLREGs rule selection
- Trajectory commands
- **Hierarch**
- **HTN**

start:
(waypoint wa)
(waypoint wb)
(waypoint wc)
(at boat s0)
(next wa wb)
(next wb wc)
(first-waypoint wa)
(last-waypoint wc)
(free s0 wa)

method sail()
pre: (at boat ?pos0) (waypoint-last ?pos0)
network: empty

pre: (at boat ?pos0), (first-waypoint ?pos1)
network: (!verify-collision ?pos0 ?pos1),
(!goto ?pos0 ?pos1), (sail)

pre: (at boat ?pos0), (first-waypoint ?pos1)
(not (free ?pos0 ?pos1))
network: (colreg-decision)

method colreg-decision()
pre: TODO

operator !verify-collision(?pos0 ?pos1)
pre: (at boat ?pos0), (first-waypoint ?pos1),
(free ?pos0 ?pos1)
eff: empty

Proposed Work

- Local guidance system
- Flowchart
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- Trajectory commands
- Hierarch
- HTN
- **Problem Constraints**

- For mission definition it will be assumed that the global motion is guided by **way-points** - one of the most common strategies applied on USV studies
- Any **speed**, **heading** and **position** of other vessel will be known in advance
- Prediction of **closest point of approach** and **intersection time** will be known in advance
- The system will only treat vessels obstacles

Proposed Work

- Local guidance system
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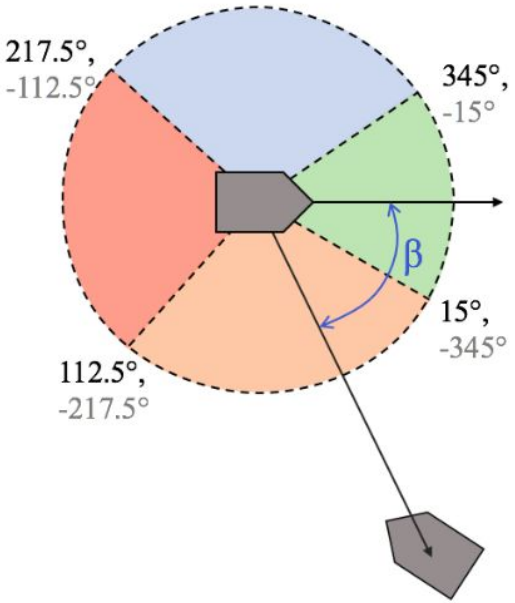
- Trajectory commands
- Hierarch
- HTN
- **Problem Constraints**



Proposed Work

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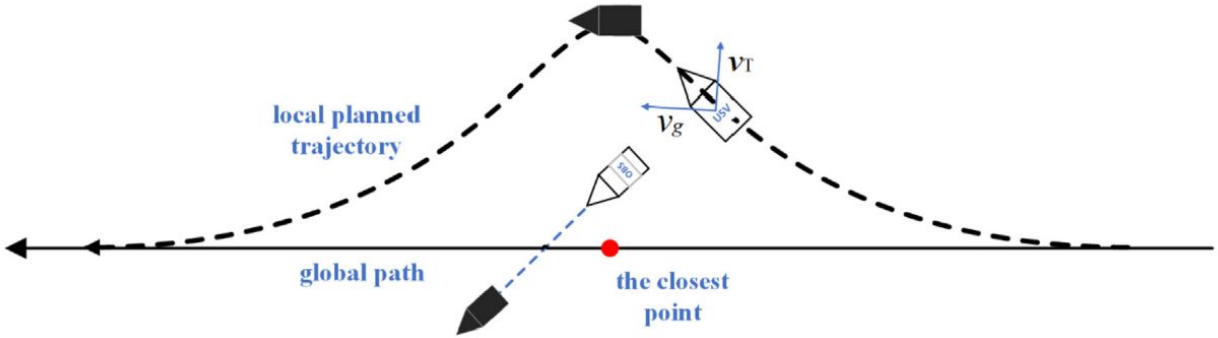
- Hierarch
- HTN
- **Problem Constraints**



Schedule

1. Development of the local guidance system based on HTN
   a. Tools installation
   b. Definition and implementation of methods and operators
   c. Test and validation
   d. Correction
2. Experiments
   a. Collision danger situations description
   b. Evaluation of guidance systems decisions
   c. Comparison of the decision and related COLREGs rule
   d. Definition of other metrics
3. Article writing

	Weeks				
Tasks	15/10 - 19/10	22/10 - 26/10	29/10 - 02/11	05/11 - 09/11	12/11 - 15/11
1					
2					
3					

Q & A