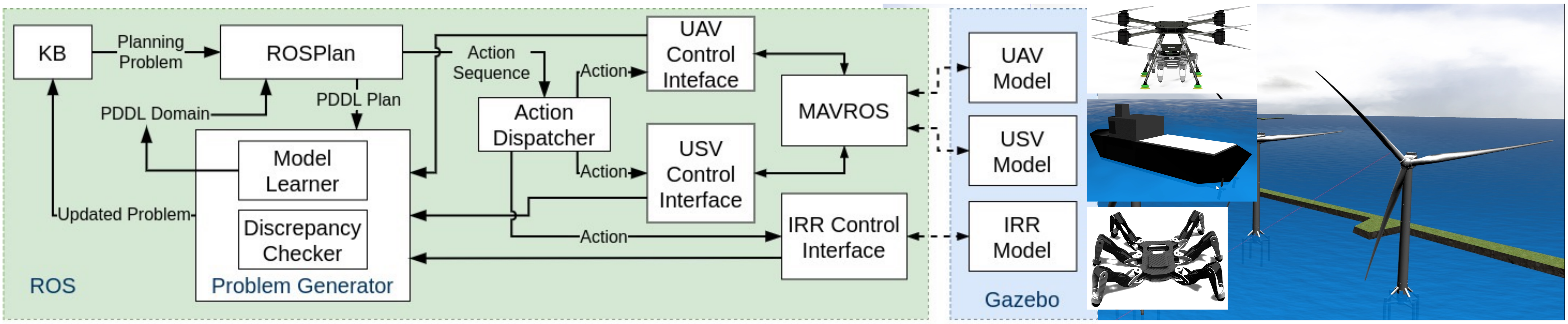
Introduction

One of the challenges in having autonomous systems in an extreme environment is to have an accurate heterogeneous multi-robot plan aiming to minimize online replanning due to incorrect domain specification. An adaptive execution monitoring system together with a temporal planning approach is utilized to mitigate. A simulated wind farm together with various autonomous vehicles is used to demonstrate our planning framework.

System architecture and simulated environment overview

Planner and Adaptive Problem Generator | **Windfarm Simulator**



- A ROS-based platform.
- KB (Knowledge Base) provides the state of the domain.
- The ROSPlan together with a temporal planner POPF is used to generate mission plans based on the KB data.
- A plan is dissected into actions and then is sent by an action dispatcher.
- An adaptive problem generator monitors the discrepancy between an actual state and its expected state; replanning is done if necessary.
- A model learner dynamically learns the stochastic of each action duration and fuel consumption rate for a better domain representation.

- A GAZEBO-based environment.
- Allow multiple instances of different robotic platforms.
- Provide a world model, robot states, capabilities, and its operating environment.

Mission Scenario Example

Total	Action	Expected
0.0	(usv_navigate usv usv_wp0 usv_wp1)	[7.0]
7.0	(uav_takeoff uav usv_wp1)	[1.0]
8.0	(uav_navigate uav uav_wp0 uav_wp1)	[8.0]
8.0	(usv_navigate usv usv_wp1 usv_wp2)	[4.0]
12.0	(usv_navigate usv usv_wp2 usv_wp3)	[3.0]
15.0	(usv_inspect_wt usv usv_wp3)	[2.0]
16.0	(uav_deploy_irr uav irr uav_wp1 irr_wp0)	[8.0]
17.0	(usv_navigate usv usv_wp3 usv_wp2)	[3.0]
20.0	(usv_navigate usv usv_wp2 usv_wp1)	[4.0]
24.0	(uav_navigate uav uav_wp1 uav_wp0)	[8.0]
24.0	(irr_navigate irr irr_wp0 irr_wp1)	[15.0]
32.0	(uav_land uav uav_wp0 usv_wp1)	[2.0]
34.0	(usv_navigate usv usv_wp1 usv_wp2)	[4.0]
34.0	(uav_refuelling uav usv uav_wp0)	[11.0]
38.0	(usv_navigate usv usv_wp2 usv_wp4)	[8.0]
39.0	(irr_ndt_inspect irr irr_wp1)	[10.0]
46.0	(uav_takeoff uav usv_wp4)	[1.0]
47.0	(uav_navigate uav uav_wp0 uav_wp2)	[4.0]
49.0	(irr_navigate irr irr_wp1 irr_wp0)	[15.0]
51.0	(uav_inspect_blade uav uav_wp2)	[3.0]
54.0	(uav_navigate uav uav_wp2 uav_wp0)	[4.0]
58.0	(uav_navigate uav uav_wp0 uav_wp3)	[4.0]
62.0	(uav_inspect_blade uav uav_wp3)	[3.0]
65.0	(uav_navigate uav uav_wp3 uav_wp0)	[4.0]
69.0	(uav_land uav uav_wp0 usv_wp4)	[2.0]
71.0	(usv_navigate usv usv_wp4 usv_wp2)	[8.0]
71.0	(uav_refuelling uav usv uav_wp0)	[10.0]
79.0	(usv_navigate usv usv_wp2 usv_wp1)	[4.0]
83.0	(uav_takeoff uav usv_wp1)	[1.0]
84.0	(uav_navigate uav uav_wp0 uav_wp1)	[8.0]
92.0	(uav_retrieve_irr uav irr uav_wp1 irr_wp0)	[8.0]
100.0	(uav_navigate uav uav_wp1 uav_wp0)	[8.0]
108.0	(uav_land uav uav_wp0 usv_wp1)	[2.0]

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