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Leverage AI to Learn, Optimize, and Wargame (LAILOW) for Strategic Laydown and Dispersal (SLD) of the USN Operating Forces

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Monterey, California: Naval Postgraduate School

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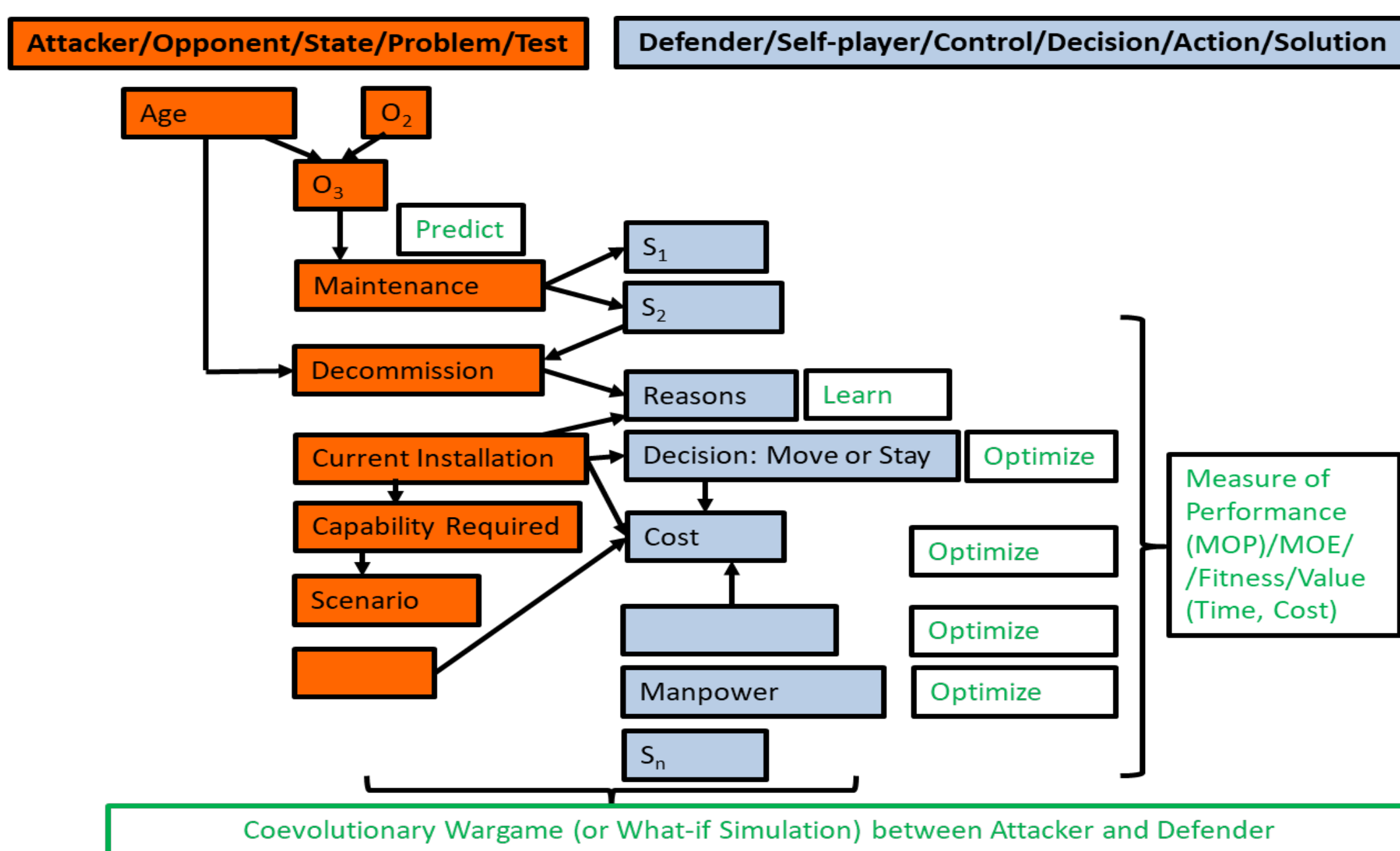
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Summary

Using Artificial Intelligence (AI), Machine Learning (ML) and Reinforcement Learning (RL) methods, we investigated how to standardize and digitize the current SLD decision making process, developed a conceptual, mathematical SLD model, to reduce manual workload from the current method, and searched for undiscovered alternatives that can reduce cost. Ultimately, we found faster and optimal solutions, AND a methodology that reveals competing ship movement alternatives.



Optimal homeport shift decisions can be difficult to determine



Our Methodology

Research Questions

- How does the Navy weight competing demands for naval forces between the CCMDs to determine an optimal dispersal of operating forces?
- How does the Navy optimize force laydown to maximize force development (Fd) and force generation (Fg) efficiency?

Ever Improving Solutions

-Found through Reinforcement Learning (RL)

Sequence	Variable	Variable Name	Mean	Soar-RL_1_1	Soar-RL_0_1	Soar-RL_1_0	Soar-RL_0_0	Defender's Reward
0	F0	(O)Age_bt_02_08	0.467889908	0.000605917	0.000137289	-1.90E-06	1.27E-06	1
9	F9	(O)CurrentInstallationGeolocation_KanedaAB	0.009174312	1.20E-05	0.000731227	0	-6.33E-07	1
41	F41	(O)Hull_DDG-119	0.009174312	1.20E-05	0.000731227	0	-6.33E-07	1
128	F128	(O)Reason_OCONUM_PACOMScenario	0.018348624	-1.36E-06	0.000744571	0	-6.33E-07	1
138	F138	(S)Decision_MOVE	0.256880734	-0.000195164	0.00093837	1.27E-06	-1.90E-06	1
155	F155	(S)NextInstallationGeolocation_YokosukaJA	0.018348624	2.40E-05	0.000719252	0	-6.33E-07	1
1	F1	(O)Age_bt_08_14	0.266055046	0.000143931	0.000599276	0	-6.33E-07	0

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Sequence	Variable	Variable Name	Mean	Soar-RL_1_1	Soar-RL_0_1	Soar-RL_1_0	Soar-RL_0_0	Defender's Reward
2	F2	(O)Age_It_02	0.091743119	-5.75E-05	0.000800722	5.93E-11	-6.33E-07	1
10	F10	(O)CurrentInstallationGeolocation_MaineUS	0.055045872	-4.09E-06	0.000747293	5.93E-11	-6.33E-07	1
41	F41	(O)Hull_DDG-119	0.009174312	1.20E-05	0.000731227	0	-6.33E-07	1
123	F123	(O)Reason_COMM	0.073394495	-8.14E-05	0.000824637	5.93E-11	-6.33E-07	1
128	F128	(O)Reason_OCONUM_PACOMScenario	0.018348624	-1.36E-06	0.000744571	0	-6.33E-07	1
138	F138	(S)Decision_MOVE	0.256880734	-0.000195164	0.00093837	1.27E-06	-1.90E-06	1
142	F142	(S)NextInstallationGeolocation_ChinhaeKR	0.027522936	1.05E-05	0.000732682	0	-6.33E-07	1

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Sequence	Variable	Variable Name	Mean	Soar-RL_1_1	Soar-RL_0_1	Soar-RL_1_0	Soar-RL_0_0	Defender's Reward
0	F0	(O)Age_bt_02_08	0.467889908	0.000605917	0.000137289	-1.90E-06	1.27E-06	1
6	F6	(O)CurrentInstallationGeolocation_GuamUS	0.073394495	7.00E-05	0.000673199	0	-6.33E-07	1
41	F41	(O)Hull_DDG-119	0.009174312	1.20E-05	0.000731227	0	-6.33E-07	1
128	F128	(O)Reason_OCONUM_PACOMScenario	0.018348624	-1.36E-06	0.000744571	0	-6.33E-07	1
138	F138	(S)Decision_MOVE	0.256880734	-0.000195164	0.00093837	1.27E-06	-1.90E-06	1
142	F142	(S)NextInstallationGeolocation_ChinhaeKR	0.027522936	1.05E-05	0.000732682	0	-6.33E-07	1

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FY 23 Plans

- Having shown our mathematical ability to solve a smaller problem using artificial data, we seek to
 - Continue our research to develop an electronic model of the Strategic Laydown and Dispersal (SLD) into a minimum variable product (MVP)
 - Assist future SLD development
 - Justify SLD potential movement scenarios and their decisions consistently
- Next Steps
 - Install LAILOW in NPS SCIF and test on real data
 - Develop a tool that can be used in the real SLD process
 - Perhaps leverage Microsoft Power BI (Business Intelligence)
 - COTS analytic and depiction tool



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