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VLS Missile Mix, Firing Policy, and Deterrence Against Red Salvos

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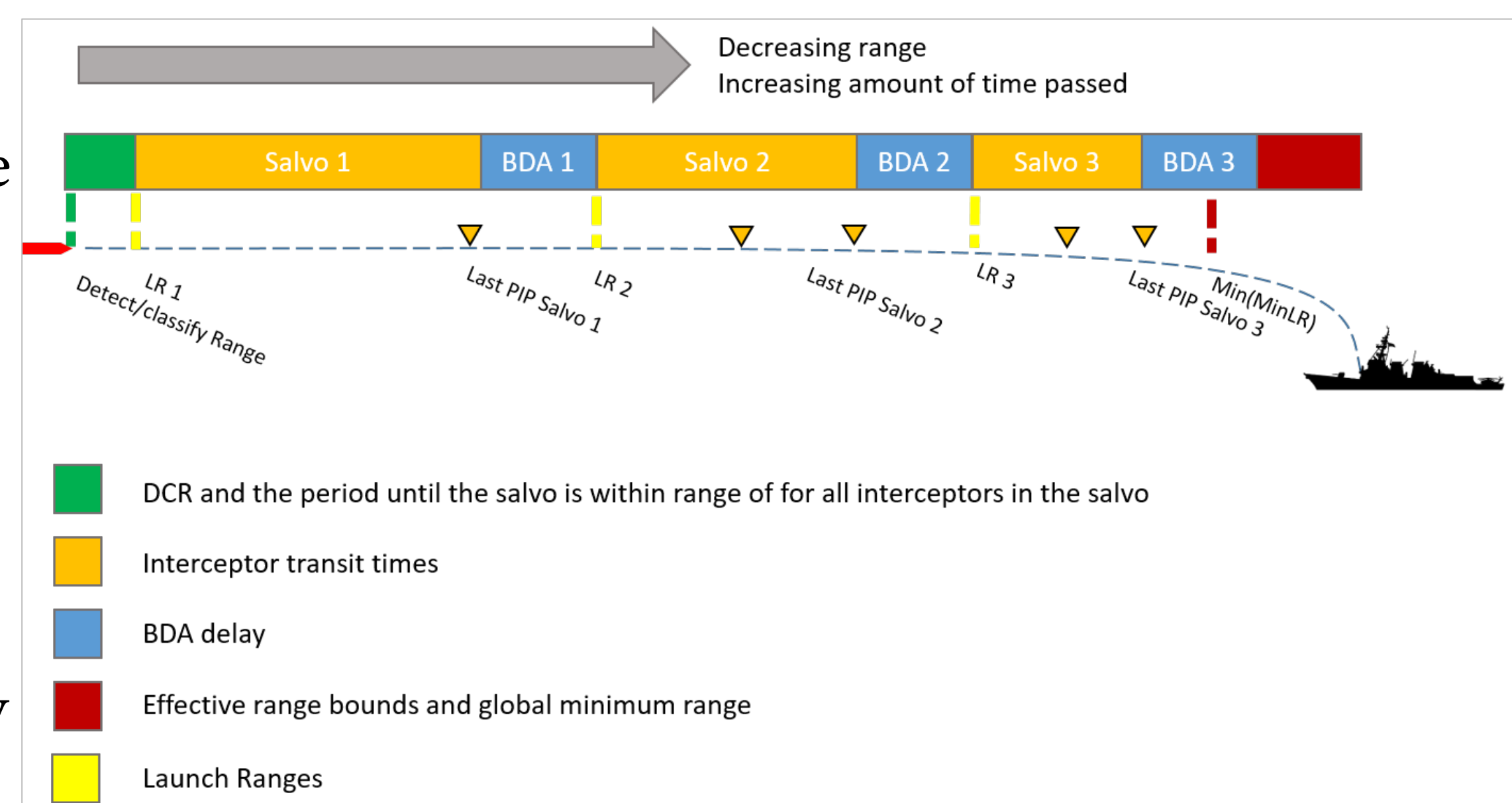
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Background

- USN utilizes the Vertical Launch System (VLS) to store and launch offensive and defensive missiles
- Since the number of VLS silos is fixed, to maximize offensive capability, the USN needs to be efficient with its defensive fire to combat incoming missiles
- This project provides an analysis tool to explore the trade-off between missile consumption and probability of raid annihilation (PRA) for various firing policies



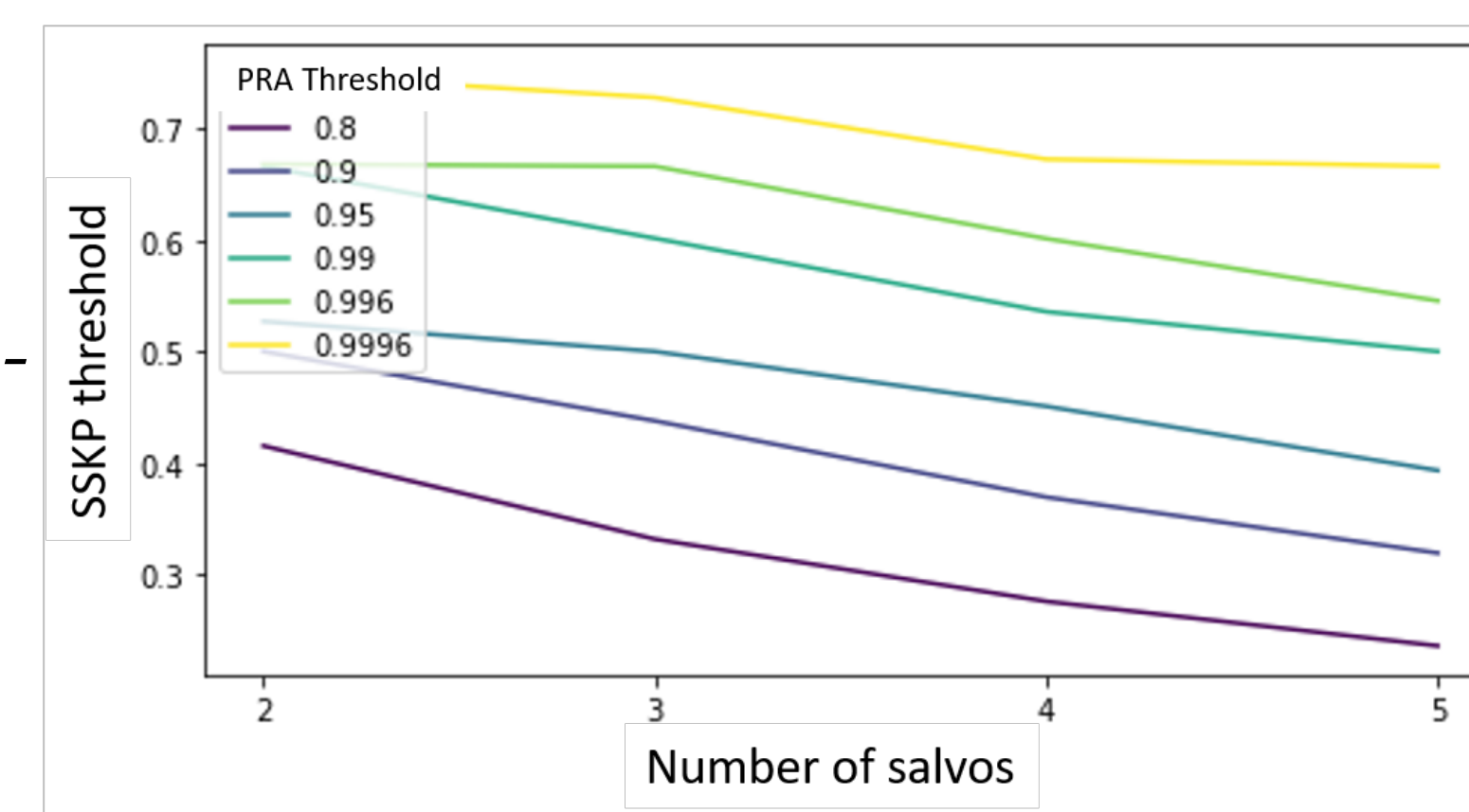
Firing sequence logic: initial detection → 1st salvo launched → BDA for 1st salvo → 2nd salvo launched → BDA for 2nd salvo ...

Model

- Incorporates real-world factors, including: multiple interceptor types, range considerations, and battle damage assessment (BDA)
- Salvo model computes the probable impact point (PIP) of each interceptor in a salvo, which directly determines the single-shot kill probability (SSKP) of each interceptor in the salvo
- Fire sequence model strings together several salvos, where the inputs of one salvo depend upon the outputs of the previous salvo
- PRA of a fire sequence computed by aggregating the SSKP across all salvos and interceptors
- Best fire sequence is the minimum cost sequence that generates a PRA above a specified threshold

Results

- One interceptor type, constant SSKP
 - Optimal firing sequence monotone non-decreasing in salvo index
 - If SSKP exceeds a certain threshold, the optimal solution is one-shot-per-salvo until the last salvo
 - Optimal solution nested as a function of total shots fired
- General Model
 - Best firing sequence usually monotonic
 - Best firing sequence usually consists of homogenous salvos
 - Reducing time to perform BDA improves performance



SSKP threshold for optimality of one-shot-per-salvo vs. number of salvos in sequence for several values of the PRA threshold

Conclusion

- Most important factor: maximizing number of salvo opportunities
- Recommendation: improve early detection and long-range missile capabilities

Future Work

- Incorporate soft-kill measures
- Extend model to multiple simultaneous threats
- Formulate Markov model to allow user to perform “what-if” analysis on firing policies and VLS loadouts



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