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ENCOUNTER MODEL

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1. Description

The Naval Surface Combat ENCOUNTER MODEL provides a numerical solution to a discrete non-homogeneous Markov stochastic process representing an engagement between two heterogeneous[1] naval forces. The model is coded in FORTRAN IV and operated on the IBM 360 or 370 computer. The forces are limited to a maximum of ten vessels each.

This model has been used to simulate "wolf-pack" tactics of hydrofoils against a light cruiser and found to be beneficial in evaluating difficult to quantify factors such as the worth of increased speed and "optimum" attack strategies.

Studies have shown the historical approach to engagement analyses utilizing deterministic models such as the Lanchester set of equations to be inadequate in itself. For example a "win" predicted from the deterministic model provides no information on the probability distribution of the "win" and does not necessarily coincide with the probabilistic mean value of the stochastic model.

[1] Two forms:
(1) estimated effect of heterogeneity derived from modified homogeneous transition intensities. (advantage = short run time)
(2) exact solution of heterogeneous forces (incomplete)

2. Input

- Red and Blue force elemental values
- Objective Value
- Each Blue and Red element
    - Initial Speed
    - Initial Location
    - Initial Heading
    - Target Acquisition Range
    - Effective Weapon Range
    - Weapon Accuracy (function of range to target)
    - Fire Rate (mean value of Poisson fire distribution)
    - Available Number of Rounds
- Vulnerability[2] (kill criteria) of each Red vessel to each Blue vessel.
- Vulnerability (kill criteria) of each Blue vessel to each Red vessel.
- Course of action for each Red and Blue element (speed and heading changes versus time),

3. Output

The output is probabilities of existence in various "states" and combinations thereof, where a "state" is defined as some combination of Red and Blue elements as either "killed" or "not killed". A "win" is defined as those states where either all Red or all Blue are "killed". Although these states are terminal in the sense that as $t \to \infty$ the sum of the probabilities of existence in these states approaches one; the engagement rarely continue to that level. Of more interest is the expected Objective Function value which utilizes the probabilities of all states, in combination with the elemental and objective values. This approach yields a comprehensive measure of effectiveness by encompassing not only the damage assessment, but the value of such damage.

[2] Expressed as a vulnerable area in past studies.