Appendix B

RAND’s Tactical Combat Simulation Environment

Seamless Model Interface (SEMINT)

The SEMINT modeling system developed at RAND integrates multiple simulation and support programs into one interconnected system. The component models have been developed by different services and analytic agencies, are written in different programming languages, and run on different hardware. In effect, SEMINT gives us the ability to improve any particular model’s algorithms without modifying them. The system links the following simulations:

- JANUS, a ground combat model;
- RTAM, a target acquisition model;
- RJARS, a ground-to-air combat model;
- BLUE MAX (fixed wing) and CHAMP (helicopter) flight path models;
- MADAM, a smart munitions damage assessment model; and
- CAGIS, a cartographic analysis and geographic information system.

By connecting these models, we can conduct a JANUS battle simulation augmented by the specialized high-fidelity computations of other high-resolution models.

Components of the System

As currently configured, JANUS conducts the ground battle, calling on RTAM to provide more accurate calculation of detection probability on special low-observable vehicles. Should the conflict involve helicopter or fixed-wing operations, the flight path simulations (BLUE MAX and CHAMP) determine aircraft flight path dynamics based on engineering-level flight performance models for the type and model of aircraft specified. These are flown against the changing threat laydown that is provided by JANUS as the battle unfolds and are then passed to RJARS, which simulates the ground-based defense reaction against the aircraft. This high-resolution simulation includes detection, tracking, jamming, SAM operations, and suppression of enemy air defenses (SEAD) with anti-radiation missiles. CAGIS provides consistent geographic information to all the simulations, while SEMINT passes messages among the models as it maintains a Global Virtual Time to keep the models in synchronization.

JANUS, a high-resolution, stochastic, two-sided, interactive, computerized ground combat simulation, lies at the heart of this system of models. It is used for combat developments, doctrine analysis, tactics investigation, scenario development, field test simulation, and training. It models up to 1200 individual combat systems, including up to 100 indirect fire systems per side, moving, detecting, and shooting over a 60-kilometer-square, three-dimensional terrain representation (Defense Mapping Agency [DMA] DTED level II data).
Combat systems (e.g., tanks, infantrymen, helicopters) are defined by the quantified attributes of the real or notional systems being modeled (e.g., size, speed, sensor, armament, armor protection, thermal/optical contrast, and flyer-type for helicopters and fixed-wing aircraft). The vulnerability of systems is characterized by probability of hit, \( P(h) \), and probability of kill, \( P(k) \), data sets individually associated with weapon-versus-system pairs. Up to 250 systems, and 250 weapons, may be defined per side. Each system may be armed with up to 15 different weapons and may search and detect with two different sensors, employing the Night Vision Electro-Optics Laboratory (NVEOL) detection model. It also incorporates a Light-TACFIRE based command and control module capable of allocating supporting fires and providing target deconfliction.

The model's graphic display capability affords the analyst the ability to examine spatial-temporal behavior, thereby aiding the analytic process by directing focus to causal chains occurring during simulation. Further, the completeness of the output available to the analyst permits a detailed examination of the individual contributions attributable to each parameter change and aids in quantifying the contribution of synergy to combat outcomes.