

# MASTER OF SCIENCE IN APPLIED MATHEMATICS

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## MODELING MAN-MADE EPIDEMICS

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Master of Science in Applied Mathematics-March 2002

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This thesis develops a mathematical model to explore epidemic spread through the Ground Combat Element (GCE) of the Marine Expeditionary Unit (MEU). The model will simulate an epidemic caused by a biological attack using an agent that has the ability to spread through person-to-person contact (small pox, hemorrhagic fever, etc.) A stochastic modeling process will be used along with widely accepted mathematical formulas for an SEIR (Susceptible-Exposed-Infectious-Removed) epidemic model. A heterogeneous population composed of numerous homogenous subgroups with varying interaction rates simulates the unique structure of military combat units. The model will be evaluated to determine which units facilitate the most rapid spread of the epidemic. The model will then test a number of different scenarios to determine the effects of varying quarantine techniques, vaccination strategies and protective postures on the spread of the disease.

**KEYWORDS:** Mathematical Modeling, Epidemics, Biological Weapons, Stochastic Process, SEIR

## ANALYSIS AND MODELING OF VIRTUAL HUMAN INTERFACE FOR THE MARG BODY TRACKING SYSTEM USING QUATERNIONS

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In this thesis, a realistic and real-time virtual human interface for Magnetic Accelerometer Rate Sensor (MARG) Body Tracking System is presented. MARG Body Tracking System is part of an ongoing research project at NPS and its goal is to design special sourceless sensors in order to track human body articulations. The outputs of the system are quaternion rotations. This thesis takes an analytical approach to quaternions by using them in the construction of a virtual human for sourceless MARG body tracking system. Visual fidelity and optimized networking capabilities are two important criteria for construction of virtual human. Implementation has been done in Virtual Reality Modeling Language and Java for one sensor and body segment and presented as proof-of-concept.

**KEYWORDS:** Motion Capture, Virtual Human, Avatar, Virtual Reality, Body Tracking System