NAVAL POSTGRADUATE SCHOOL
Monterey, California

DISSERTATION

INERTIAL AND MAGNETIC TRACKING OF LIMB SEGMENT ORIENTATION FOR INSERTING HUMANS INTO SYNTHETIC ENVIRONMENTS

by

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Current motion tracking technologies fail to provide accurate wide area tracking of multiple users without interference and occlusion problems. This research proposes to overcome current limitations using nine-axis magnetic/angular rate/gravity (MARG) sensors combined with a quaternion-based complementary filter algorithm capable of continuously correcting for drift and following angular motion through all orientations without singularities.

Primarily, this research involves the development of a prototype tracking system to demonstrate the feasibility of MARG sensor body motion tracking. Mathematical analysis and computer simulation are used to validate the correctness of the complementary filter algorithm. The implemented human body model utilizes the world-coordinate reference frame orientation data provided in quaternion form by the complementary filter and orients each limb segment independently. Calibration of the model and the inertial sensors is accomplished using simple but effective algorithms. Physical experiments demonstrate the utility of the proposed system by tracking of human limbs in real-time using multiple MARG sensors.

The system is "sourceless" and does not suffer from range restrictions and interference problems. This new technology overcomes the limitations of motion tracking technologies currently in use. It has the potential to provide wide area tracking of multiple users in virtual environment and augmented reality applications.

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