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Technology: Nanotechnology Modeling

Big Dividends Through Nano Modeling

Introduction

Nanoscience and nanotechnology are two of the hottest research and development fields. The potential to design nanoscale devices—about one billionth of a meter—enables an approach to science and engineering that seems more like science fiction. Nanotechnology offers access to quantum and semi-classical effects enabling new capabilities tailored to emerging global security demands far better than many state-of-the-art technologies used today.

The goal of the Lockheed Martin (LM) Nanotechnology Strategic Technology Thread (STT) is to provide integrated nanotechnology solutions for defense and global security. LM Advanced Technology Laboratories (ATL) formed the Computational Physics Group to provide the Nanotech STT Modeling and Simulation Team with demonstrated expertise in nanotech theory, modeling, and engineering.

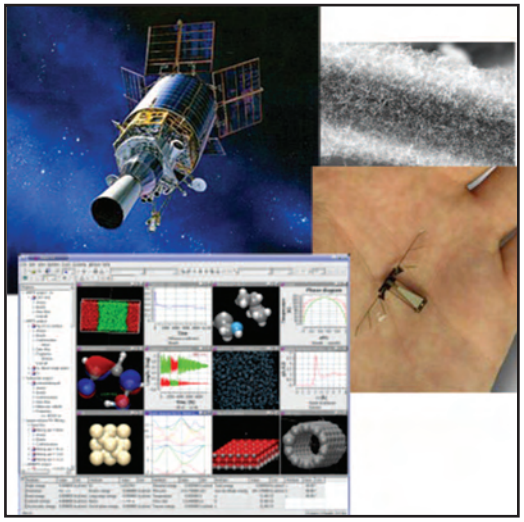
Research Areas

Developing the engineering toolkits needed to investigate the use of nanotechnology in the design of new materials, the group bridges the gap between contemporary theoretical research and experimental practice. Nanotechnology work at ATL is divided into four areas.

The *Nanotube Based Sensors* area models the electronic properties of nano-materials designed to enhance the detection and resolution of optical and electromagnetic sensors. Advanced theoretical analyses and sophisticated simulations guide the development and design of next-generation sensor devices.

The *Material Structures Analysis* group models and extracts crucial material properties to find underlying relationships between nanomaterial structures, processing, and performance. Through an innovative combination of multi-scale physics models and informatics, the key features of nanomaterials are optimized to reach multiple objectives of weight reduction, strength improvements, and/or controlled thermal and electrical performance.

Nanobiotechnology uses nature to find solutions to sensing, energy harvesting, and molecular recognition. This group focuses on development of novel sensors for detection of chemical and biological warfare agents; diagnostic technologies; bio-facilitated energy harvesting for small, portable energy needs; and bio-mimetic approaches to environmental adaptation.



Nanotechnology Modeling and Simulation predicts how a nanoscale device will behave on the macro-scale. The ATL research areas cover RF and IR Sensors, Nanomaterial Structures, Nanobiotechnology, and Quantum Control.

Our *Quantum Control* research examines femtosecond laser pulses (photonic reagents) shaped by machine learning to drive specific electronic and atomic transitions inaccessible through traditional chemistry or spectroscopy. This technique is driving toward remote chemical and biological detection, and provides a means to control nanomaterials at the molecular scale.

Future Work

Advancements in the nano domain come largely through co-dependent relationships between scientific exploration and technology applications. Through collaborations with other LM business areas and technology centers, universities, and companies with nanotechnology expertise, the ATL Computational Physics Group has organized diverse knowledge resources crucial to the highly interdisciplinary field of nanotechnology. The group is positioned to lead modeling and simulation for virtual nanotechnology exploration and to accelerate development and transition nanotechnology into LM products at reduced cost and risk.

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