

Educational Extensions of Large-Scale Simulations Enabled by High Performance Computing

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Outline of Presentation

- **Problem and Background**
- **Large-scale simulations**
- **High Performance Computing**
- **DoD education environment and goals**
- **Collaborative Learning**
- **Distributed education**
- **Implementation issues**
- **Assessment**

Problem and Background

- Education is major need in DoD today
- Targets for education are:
 - Globally distributed
 - Heavily engaged in randomly scheduled activities
 - Often highly stressed
 - Frequently isolated
 - Conversely, frequently in crowded conditions
- While not the primary mission of the DoD, it is a necessary element of maintaining the force

Major Thesis:

Modern pedagogical theory can be effectively implemented to achieve DoD educational goals using High Performance Computing.

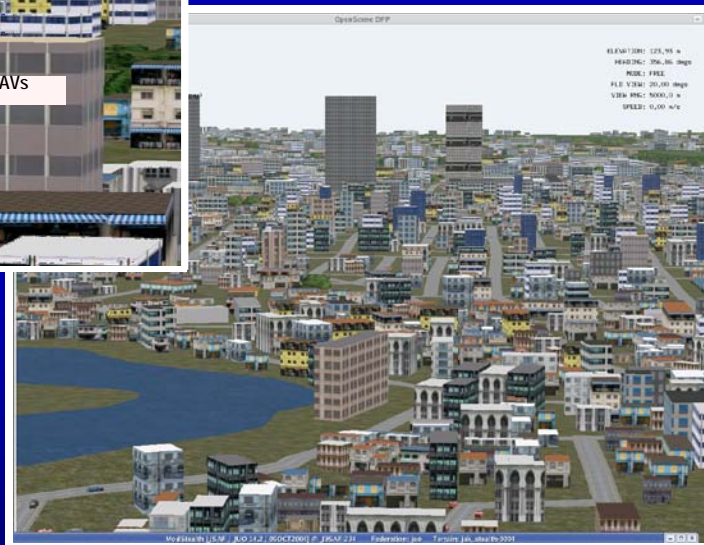
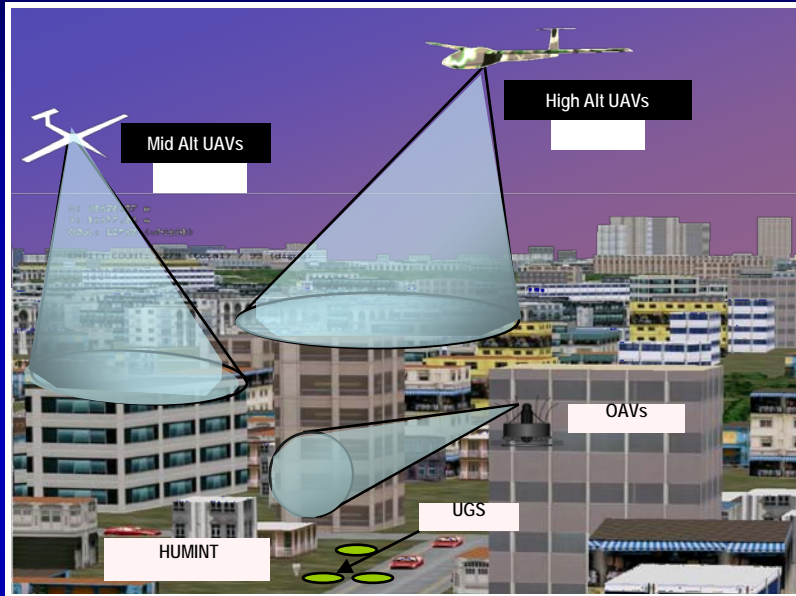
Large-Scale Simulations

- **DoD has need for battlefield simulations**
- **Sand-tables have given way to computers**
- **Intelligent agent simulations are effective**
- **Models are extant for wide range of “entities”**
 - **Combat vehicles**
 - **Combat personnel**
 - **Civilian vehicles**
 - **Civilian personnel**
 - **Infrastructure**
- **Interactive, Human-in-the-loop computer environments**

JFCOM JSAF

- **Joint Semi-Automatic Forces simulation**
- **One of large family of simulations**
- **Used for:**
 - Training
 - Operations analysis
 - Projections of use of new technology/weapons
- **Available to all of DoD**
- **Used in very distributed mode**
 - Hawai'i to Virginia
 - Florida to Ohio

Urban Resolve using JSAF

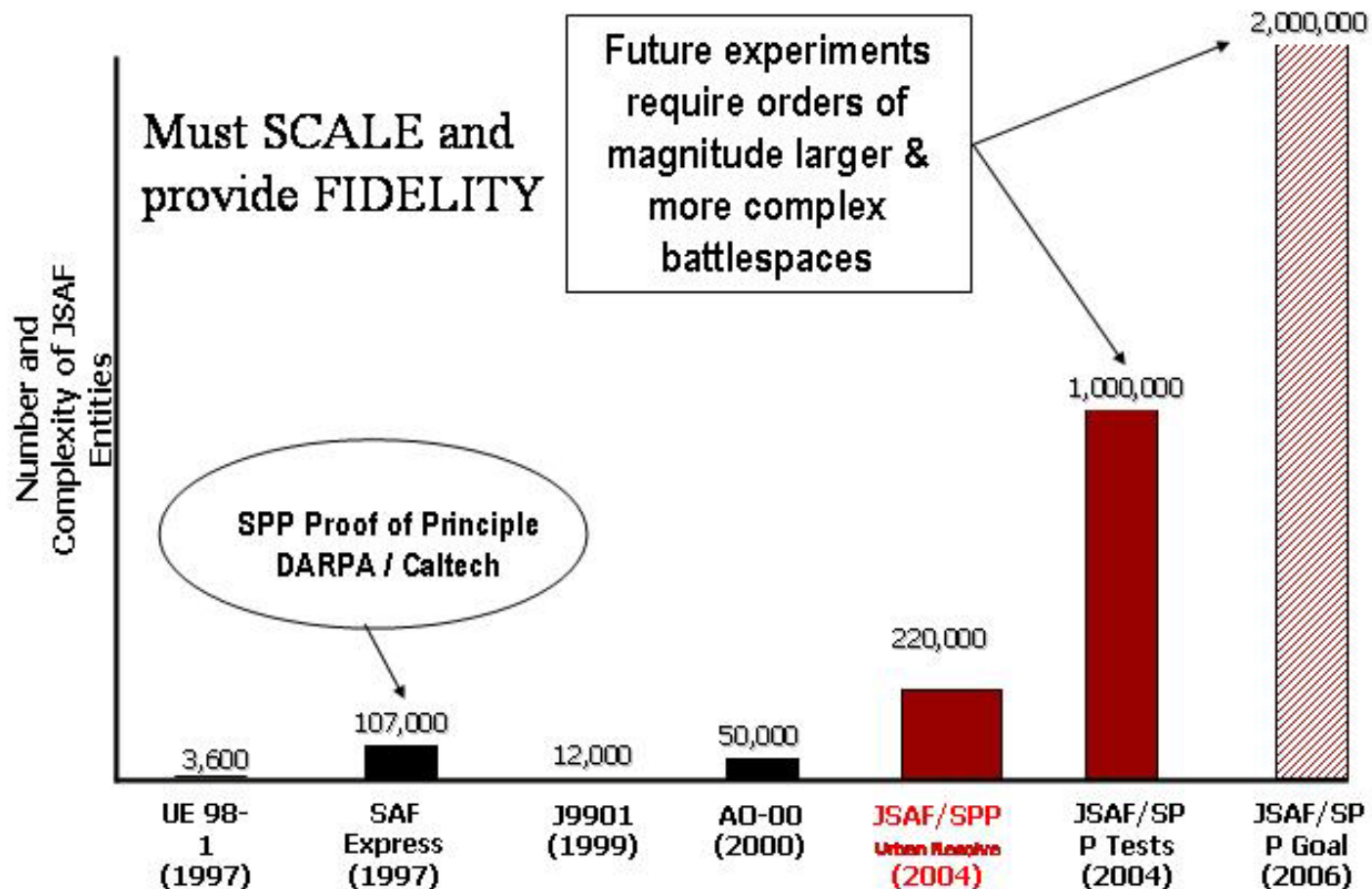


High Performance Computing

- Definition??
- History
- Utility
- Common instantiations
- Availability
- Resistance to
- Range of capabilities
- Getting the right assistance
- Success stories
- Early forays into education



Need and Delivery



DoD Education: Environment and Goals

- Training - Focused program that leads to high proficiency in a specific skill
- Education - allows the service member to
 - attack problems not envisioned as part of their MOS
 - prepare for career advancement.
- American armed forces are famed for initiative
- Prepares the service member for broad range of problems
- Current DoD operational environment calls for more education, but places more constraints on the process

Cognitive Science and DoD Education

- Meaningful learning for diverse situations occurs when one can:
 - apply abstract knowledge in multiple authentic contexts
 - receive feedback on the validity and success of the application
 - re-engage in instruction with refined knowledge targets.
- Majority of learners work passively from a textbook
- They rarely engage in the content in the depth described above
- Cannot actually use the taught knowledge in varied contexts
- HPC technology provides a opportunity to engage learners in real-time authentic contexts most relevant to their desired training
- DoD would accelerate the learning curve and raise the competency by:
 - providing immediate, repeated and dynamically optimized simulation
 - Making learners synthesize and apply their developing content knowledge
- HPC would also provide for incorporating the new knowledge of service members who had been in the field and provide input to system

DoD Instruction 1322.25

- E3.1.1.1. Provide for the **academic, technical, intellectual, personal and professional development** of Service members, thereby contributing to the readiness of the Armed Forces and the quality of life of Service members and their families.
- E3.1.1.2. Increase Service members' opportunities for **advancement and leadership** by reinforcing their academic skills and occupational competencies with new skills and knowledge.
- E3.1.1.3. **Lead to a credential**, such as a certificate, diploma, or college degree, signifying satisfactory completion of the educational program.”

Collaborative Learning

- **Beyond “group work”**
- **Intensifies engagement with knowledge and range of feedback**
- **Extends simulation to likely multi-player scenarios that would occur in real context**
- **Access to distributed cognition**
- **Superior problem-solving outcomes**
- **HPC could allow parallel participation by experts and novices with varying levels of support based on experience, learning style, need for data, culture**
- **Can help expose misconceptions and lower affective filters**

Distributed Education

- DoD has many requirements for educating its members
- Current global engagement requires personnel who have:
 - exceptional cultural awareness
 - intuitive sense for the nature and character of war
- Gen. Scales argues higher-level military schools fail to meet learning needs
- Education necessary to gain a deeper understanding of the issues of consequence to the nation
- Education necessarily must be a life-long process
- Service members need unfettered and continuous access to the best and most inclusive educational programs
- HPC can provide the capability of expanded distance learning
- Service members can learn to their own capacity and motivation

JIOC Distributed System Needs

Joint Information Operations Center (JIOC) is responsible for the integration of Information Operations (IO)

- This involves collaboration with dimension of heterogeneity along several axes:
 - unit
 - language
 - mission
 - tradition
- Training for collaborative activities is a major goal
- Personnel will have to develop and hone collaborative skills
- Cost of physically moving personnel would be prohibitive
- Time conflicts of operational personnel preclude education
- Distributed platform provided to JFCOM may hold promise for resolving this conundrum

Implementation Issues

- **Maintain a focus on designing HPC-supported strategies for managing the variables present in the learning process, not just the content being learned**
- **Feedback loop - room for players and designers to co-construct modules to continually bring into the light what “we don’t know we don’t know”**
- **Issues dealing with the automatic incorporation of new material, e.g. how to turn books like “The Pentagon’s New Map,” “The World is Flat” and “Disruptive Technologies” into interactive education programs**
- **Effectively using a broad spectrum of computer generated capabilities to individually tailor education to the DoD professional**

Assessment

- **Thoughtful goals**
- **Rigorous interviewing**
- **Focus not just on discrete knowledge acquired but synthesis of knowledge in real tasks**
- **Emphasis on evidence and communication of strategies**
- **Pre- and post-instruction assessment/task**
- **Periodic assessment integrated into module**
 - **Reflection opportunities**
 - **Player creation of rubric/criteria for assessing own performance**
 - **Can be element of leadership development**

Vision and Future Needs

- **Major stumbling block – Knowledge acquisition (KA) and content development**
 - Costly, time consuming, and fraught with bias perils.
 - Envisioned solution:
 - HPC-enable automatic KA
 - Artificial intelligence (AI) to aid content development
- **Obstacle – Globally dispersed personnel**
 - DoD personnel in remote sites and working unscheduled times
 - Envisioned solution
 - Globally distributed, highly interactive, AI optimized education
 - Leverage the “best and brightest” instructors and render their presentations in “live” MPEG clips to provide a realistic “Turing Test” interaction.

Conclusions

- **Simulation and training have benefited from high performance computing**
- **Education needs newly developed capabilities to keep up with modern demands**
- **Users, educational assets and computing are often dispersed geographically**
- **Technology is available to deliver HPC power to educational systems**

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