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Next-Gen Fire Control: Free Software & Video Game Math

Marc Santoro

Anthony D'Alessandro

Special Mission Weapon Systems

Naval Surface Warfare Center, Dahlgren Division

Distribution Statement: (A)
Approved for public release; distribution is unlimited.

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Outline

- Developing a Fire Control System
- Integrating New Approaches
- The Tools
- Video Game Math
- Roadmap of Future Technology
- Conclusions

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The System

- Medium-Caliber Fire Control System
- Non-Traditional Customer
  - Airborne
  - Rapid Development
- Existing system inappropriate
  - Physically large
  - Developed using legacy tools
- Concept to delivery in 1/3 time for typical system
- Significant COTS components

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Open Approach

- Open Source tools are high quality
- NSWCDD gradually introduced open source into Naval Fire Control
- New software architecture based on Open Source
- Hardware Interfaces
  - DoD Mount, Wescam EO/IR, ATK Gun, C2/C4ISR
- Ballistics Simulation – 4-DOF MPM
- Servo Control – Discrete PID
- State Estimation/Filtering - Alpha-Beta, R-C

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The Tools

- Linux
- GNU Toolchain (C++)
- TRAC
- Git
- Python
- Sage
- Octave
- KST
- OpenJava
- R
- Open/LibreOffice

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Video Game Math

- Fire Control overlaps video game technology goals
  - Accurate Simulations
  - High Performance
    - Processing
    - Networking
- Strong commercial demand
  - Technical Expertise & Resources
- Linear Algebra
- Signal Processing

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Linear Algebra

- Strong overlap between FC and games
- Parallax
  - Direct solution derived from fundamental math
- Ballistics
  - 1:1 match between implemented ballistics model and idealized 4DOF model

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Graphics Cards

- Contain integrated processors with massive capacity
- Used to accelerate certain signal processing operations
- Real-time Video Decoding; 3D (georectified) overlays
- Developers use a C-like language

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State Estimation

- Analogies between commercial sector & DoD interests
- Alignment (Parallax)
  - Computer Vision
- Target Tracking
  - Video Games

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The Future

- Utilize application-specific COTS components
  - Digital Signal Processing
  - Graphics Processing Units
  - COTS I/O
- Minimization
  - Small-form-factor rugged platforms
- Simplification
  - Identify and reuse analogous technology
  - Obsolescence

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Conclusions

- Investing in knowledge capital
  - Identify trends in commercial technology that parallel DoD needs
  - Prioritize technical subject-matter expertise
- Minimized investment in specialized technology
  - Long-term reuse potential is over-estimated
  - Extensive investment in component reuse is inefficient
    - Components end up specialized anyway
    - Focus on capturing knowledge

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