**Visualization for Decision Superiority**

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Purpose

Explain how different visualization techniques can aid decision makers in shortening the decision cycle, decreasing information uncertainty, and improving situational awareness.
Based on 2 Papers

- Increasing Situational Awareness by Combining Realistic and Non-Realistic Rendering Techniques
  - Valerie A. Summers¹, Aline Normoyle¹, Robert Flo²

- Increasing Situational Awareness by Visualizing Uncertainty
  - Valerie A. Summers¹, Richard L. Jones¹, Robert Flo²

MÄK Technologies¹ U.S. Air Force, Rome Labs²
Visualization of Information is not...

- Fusing information
- Improving information estimates
- Collating multiple information sources

Visualization is displaying information graphically on a display
Where Visualization Fits

- ITT Hazardous Plumes Model
- Opnet Communications Model
- MAK VR-Forces simulation engine
- Network Protocols
  - MAK RTI
  - MAK VR-Link

Model/View Control
- Opnet 3DNV
- MAK VR-Forces GUI

Visualization
- MAK StealthXR
- MAK Plan View Display
- MAK Stealth
Availability

- Products commercially available
- Available through the U.S. Air Force for other programs
- Works out of the box with HLA, DIS
- Use plug-in API to work with Link16
- C2PC injector stimulated via HLA
- Various platforms including MS Windows and Linux
Requirements Source

- Human computer interaction research
- Military subject matter experts
- Toolkit Customers (both foreign and domestic)
- Feedback from fielded simulation applications
Visualization Goals

- Reduce information process time for decision makers
- Enable information manipulation
  - Filter
  - Clarify
  - Value
- Improve situational awareness of the known, unknown, and the uncertain
## Knowledge Organization

<table>
<thead>
<tr>
<th>Knowledge voids</th>
<th>Collection plan emphasis</th>
<th>Altitude, timeliness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coverage + no threats</td>
<td>Supply / evacuation routes</td>
<td>Visualization of uncertainty</td>
</tr>
<tr>
<td>Coverage + threats</td>
<td>Time Sensitive Targeting</td>
<td>Clutter (too much data) Confidence values</td>
</tr>
</tbody>
</table>
Software Development Goals

- Enable display customization
- Enable de-cluttering the display
- Integrate
- Cross-tool control
- Toolkit
- Visualization techniques work together
Approach: 3 non-realistic techniques

- Visualization of non-visual data
- Alternative visualization
- Data reduction
Criteria for Visualization of Non-visual Data

- Relevant to user
- Help user with his/her task
- Have a spatial representation
Dynamic Spatial Data – Changes rapidly over time

- Biological, chemical or nuclear plumes
- Communication lines
- Threat ranges
- Sensor coverage
- Drop down lines with altitude labels (precise XY location not obvious in perspective views)
- Trajectory histories (help predict future locations and AARs)
- Inter-visibility lines
Weapons of Mass Destruction
Nuclear, Biological or Chemical
Weapons of Mass Destruction
Nuclear, Biological or Chemical
Weapons of Mass Destruction
Nuclear, Biological or Chemical

X
Communications
Weapon System Threat Envelopes
Sensor Coverage
Static Spatial Data

- Tactical graphics
  - Planned routes
  - Waypoints
  - Areas of impassible terrain
  - Phase lines
  - Engineering objects
  - ...

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Tactical Graphics
Approach: 3 non-realistic techniques

- Visualization of non-visual data
- Alternative visualization
- Data reduction
Deciding Which to Use

- **Realistic**
  - + Unit details
  - + Emotional factors
  - - Screen clutter (no scaling or aggregation)
  - - Worst performance

- **Non-realistic (Impressionistic)**
  - + Partial unit detail (force id and orientation)
  - Faster performance than realistic

- **Symbolic Billboards**
  - - Unit details except orientation
  - + Reduce screen clutter
  - + Best performance
Alternative Terrain Scaling

Terrain drawn to scale

Exaggerated scaling
Alternative Terrain Coloring

Contour shading

Drape political raster map
Combining Techniques

Exaggerated scaling AND contour shading

Exaggerated scaling AND political raster map
Approach: 3 non-realistic techniques

- Visualization of non-visual data
- Alternative visualization
- Data reduction
  - Eliminate
  - Compress
Too much data!
Data Elimination

- **Shared Overlays**
  - Networked sharing of data
  - Whole screen
  - Examples: enemy force template, coordination info. (phase lines, fire control lines, maneuver)

- **User Controlled Filters**
  - Not shared
  - Whole screen or just a subset
  - Examples: line of sight, hide ineffective air defense units

- **Automatic**
  - Hide unit effects with non-realistic units
All Overlay Layers – Too Cluttered!
Intel Collection Assets
Data Consolidation

- User controlled dynamic scaling
- Aggregation (combine units)
  - Exact same type
  - Identical platform / domain / force
- User defined cluster rules
Technique Interaction

- **Point of view**
  - Saved defaults
  - Customized views
  - Cross tool control through other applications
  - Zoom level to see different levels of detail

- **Other Data Representations**
  - Organizational structures
  - Unit capabilities (sensors etc.)

- **Reducing Confusion**
  - User customization (Colors / styles for vast number of options)
Results

- Positive feedback from
  - Simulation Interoperability Workshop (SIW) 2004
  - International Training Education Conference (ITEC) 2004
  - C4I Summit 2004
  - Transformation and Operations (TOPS) in Cyberspace 2004

- Used by
  - OpNet as base toolkit for 3D NV
  - ITT visualization of hazardous plumes models
## Future Work

- User Studies
- Better data filtering
- Knowledge voids
- Automated data displays
- Increased performance
 Acknowledgements

Supported through:

- DoD Small Business Innovative Research Program (SBIR),
  - AF02-109 “Multi-sensory display toolkit” (U.S. Air Force, Rome Labs)
  - A99-040 “Display Management for Command and Control Applications” (U.S. Army, CECOM)
- Internal product development.
Questions?