

Retrieval of Hidden Data

The Flip Side of Decluttering

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Agenda

- ▶ Data, Information, and Visualization
- ▶ Clutter
 - ▶ What it is
 - ▶ Why clutter is a problem
- ▶ Clutter Reduction
 - ▶ Why clutter reduction is a problem
- ▶ Balance needed to support decision makers
 - ▶ Techniques for removing clutter
 - ▶ Techniques for retrieving the details
- ▶ Future work

Data vs. Information

- ▶ Data – raw facts
 - ▶ Numbers, characters, images
- ▶ Information – processed data
 - ▶ Data that is received and understood within a context becomes *Information*
- ▶ Decision makers use information, not data
- ▶ Presenting too much information at once causes Information Overload

Data Visualization

- ▶ One goal of Visualization is to turn large amounts of data into manageable chunks of information
 - ▶ “A picture is worth a thousand words”
- ▶ Explorative process
 - ▶ User controls where, when, and how data is displayed
 - ▶ Key is *interactive* control
- ▶ Shneiderman’s taxonomy of visualization
 - ▶ “Overview first, filter and zoom, then details on demand”

What is Clutter?

- ▶ Things that cause confusion in a visual display
 - ▶ Too many objects in the field of view
 - ▶ Non-relevant mixed with relevant
- ▶ Not just amount of data displayed, but how it is displayed
 - ▶ Tufte's "chartjunk": elements of a display that don't provide information, and may actually obscure relevant data

Problems Arising from Clutter

- ▶ Clutter leads to degradation of performance
 - ▶ System performance
 - ▶ Human performance
- ▶ Clutter can hinder Decision Making
 - ▶ Patterns obscured by non-relevant data

Clutter Reduction Techniques

- ▶ Data Elimination
 - ▶ Remove it automatically
 - ▶ User controllable filters
- ▶ Data Consolidation
 - ▶ Combine into higher-level representations
- ▶ Alternate Representations
 - ▶ Display same data in a different fashion

Problems Caused by Clutter Reduction

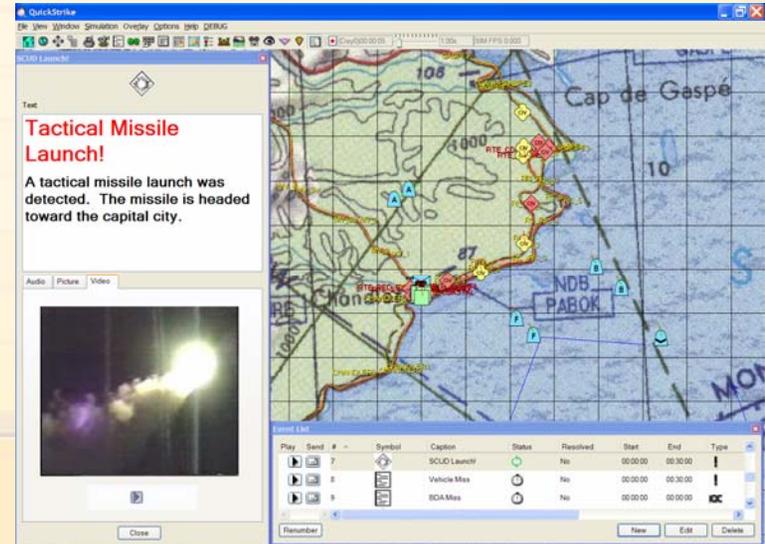
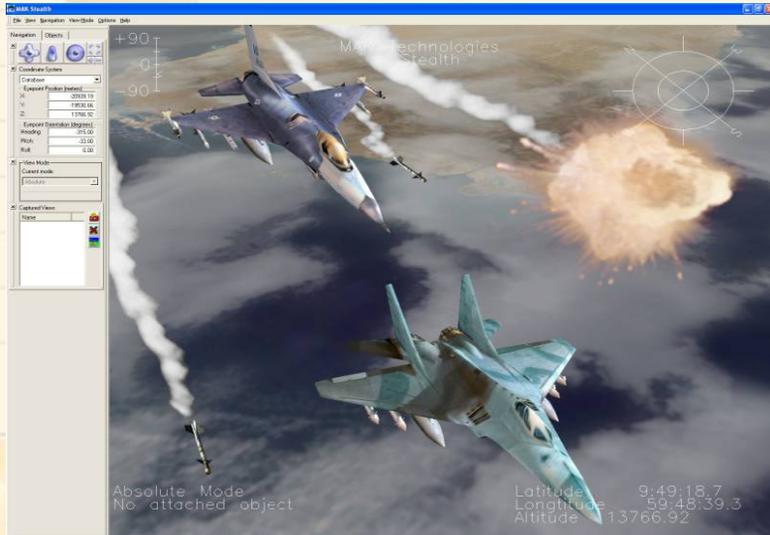
- ▶ How does user know that any data was removed?
- ▶ Once they know, how do they retrieve it?
- ▶ How can the retrieved data be displayed most usefully?
 - ▶ Within context
 - ▶ Appropriate format
- ▶ Solution: “Details on demand”

Details on Demand

- ▶ To achieve details on demand, provide the user with interactive controls
 - ▶ Facilitate exploration of data
- ▶ Customize detail access based on data attributes:
 - ▶ Data dimensions: 2D, 3D, 4D, higher
 - ▶ Modalities: text, imagery, events, audio, video
 - ▶ Levels of detail: theatre, urban environments
- ▶ Only show what is needed, when it is requested

Application Focus

- ▶ MAK StealthXR
 - ▶ Network visualizer for displaying DIS/HLA data in 3D
 - ▶ Typically data from simulations, but not necessarily
- ▶ MAK QuickStrike trainer
 - ▶ Designed to drive decision making during dynamic targetting



Clutter in 3D

- ▶ Clutter in 3D comes from rendering too many objects
 - ▶ High number of objects in scene
 - ▶ Arrangement of objects relative to terrain
 - ▶ Hills, trees, buildings
 - ▶ Particularly a problem in Urban environments

Data Elimination in 3D

- ▶ Traditional 3D rendering techniques
 - ▶ Clipping: remove what isn't in the field of view
 - ▶ Level of Detail: Objects at a distance rendered at lower fidelity
 - ▶ Close: photo-realistic
 - ▶ Medium: simple polygon model, icon
 - ▶ Far: pixels

Data Consolidation in 3D

- ▶ StealthXR employs dynamic aggregation, combining entities of similar type when viewed from a distance



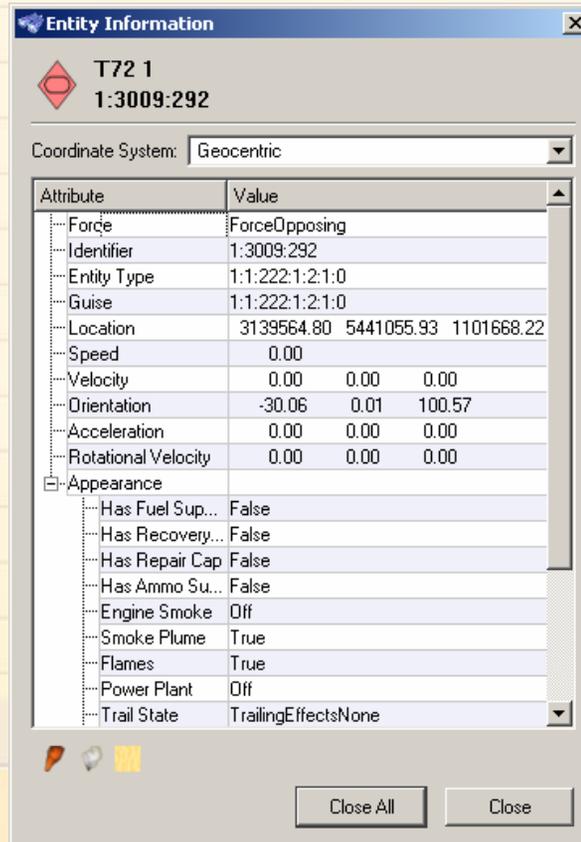
Details on Demand in 3D

- ▶ 2D overlays on a 3D scene provide additional information



Details on Demand in 3D

- ▶ Deeper information can be retrieved from dialog windows



Entity Information

 **T72 1**
1:3009:292

Coordinate System:

Attribute	Value
Force	ForceOpposing
Identifier	1:3009:292
Entity Type	1:1:222:1:2:1:0
Guise	1:1:222:1:2:1:0
Location	3139564.80 5441055.93 1101668.22
Speed	0.00
Velocity	0.00 0.00 0.00
Orientation	-30.06 0.01 100.57
Acceleration	0.00 0.00 0.00
Rotational Velocity	0.00 0.00 0.00
Appearance	
Has Fuel Sup...	False
Has Recovery...	False
Has Repair Cap	False
Has Ammo Su...	False
Engine Smoke	Off
Smoke Plume	True
Flames	True
Power Plant	Off
Trail State	TrailingEffectsNone

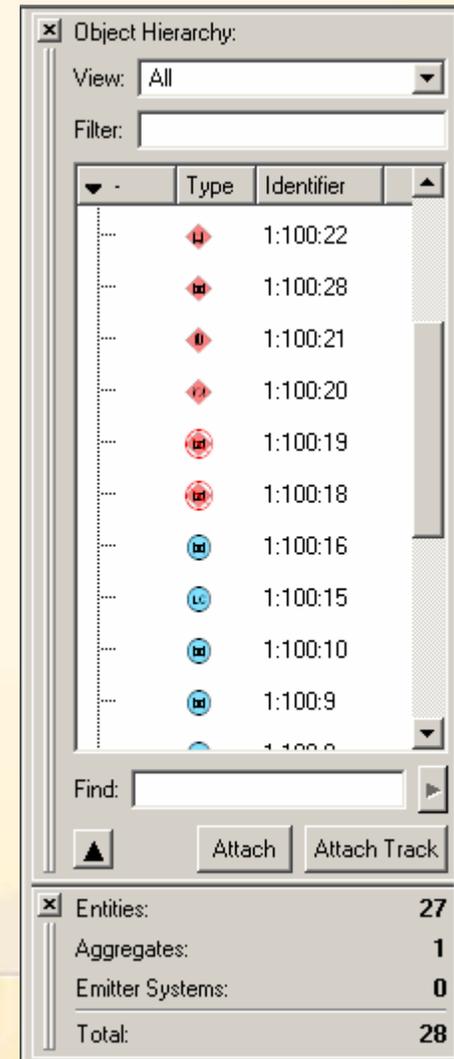
Close All Close

Clutter in 2D

- ▶ 2D data tends to be textual in nature
 - ▶ Large blocks of text
 - ▶ Lists of items, text / icons
- ▶ How long to locate an item in a list?
 - ▶ Hick-Hyman law, $T = b \log_2 (n+1)$

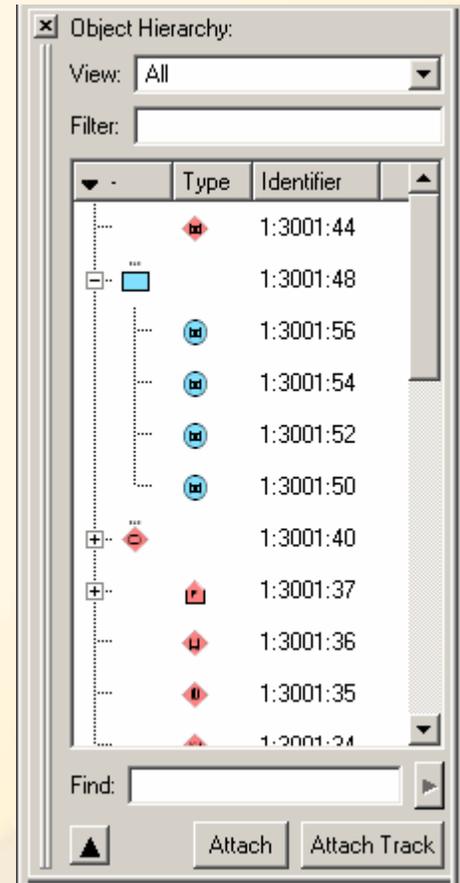
Clutter in 2D

- ▶ The Object Hierarchy list in StealthXR lists every entity it is aware of
 - ▶ Potentially thousand of entries!



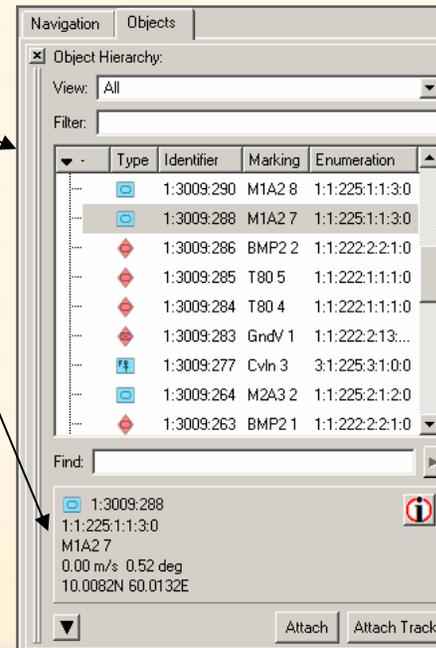
Removing Clutter in 2D

- ▶ Data Elimination: filters
 - ▶ Restrict list to certain entity types
 - ▶ Filter list by textual information
- ▶ Data consolidation
 - ▶ Aggregate hierarchies
- ▶ Additionally, a search field is provided to locate specific entries in list
 - ▶ Similar in style to web browsers



Details on Demand in 2D

- ▶ While filters and aggregation can reduce the amount of data that needs to be displayed and updated, the user may want to drill down
 - ▶ Optional columns
 - ▶ Detail panel at bottom

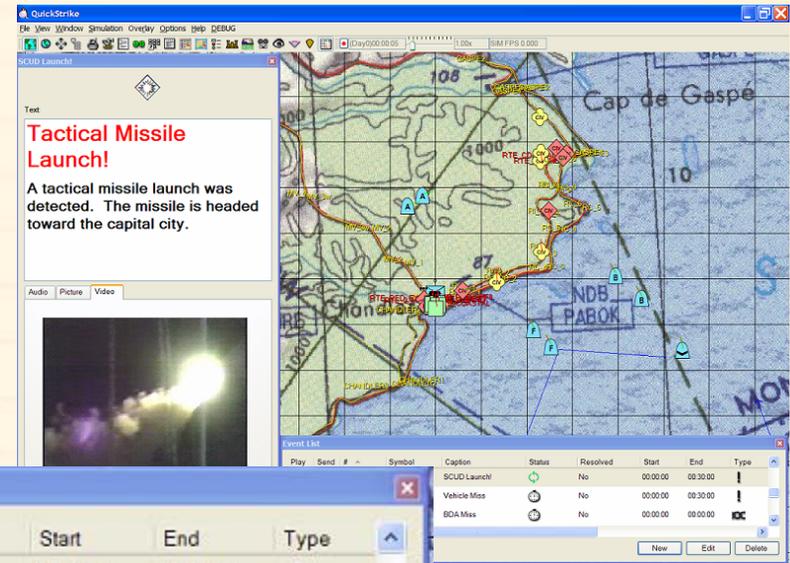


Temporal Non-Visual Data

- ▶ Events happen during the course of a scenario, possibly several at a time
- ▶ Several techniques exist to inform users about events
 - ▶ Pop-up windows
 - ▶ Passive, transient text
 - ▶ Audio alerts

Removing Temporal Clutter

- ▶ The QuickStrike trainer provides a single panel with 'backlog' management
 - ▶ New events are queued
 - ▶ User control of view



Event List

Play	Send	#	Symbol	Caption	Status	Resolved	Start	End	Type
		7		SCUD Launch!		No	00:00:00	00:30:00	!
		8		Vehicle Miss		No	00:00:00	00:30:00	!
		9		BDA Miss		No	00:00:00	00:00:00	! BCC

Buttons: Renumber, New, Edit, Delete

Conclusions

- ▶ Following the visualization philosophy “overview first, filter and zoom, details on demand” facilitates effective decision making
- ▶ Key features
 - ▶ Provide ability to retrieve relevant low-level data
 - ▶ Retrieval access under real-time user control
 - ▶ Maintain context while providing relevant details

Future Work

- ▶ Future enhancements
 - ▶ Dynamic aggregation
 - ▶ Improved object hierarchy
 - ▶ User studies of comparable techniques

Questions?

▶ Any questions?

Thanks for attending!