Distributed Common Ground Station - Army

An Approach to Information Fusion Architecture Design

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Integrating Human and Automatic Processes: “Level 5 Data Fusion”

1. Data Presentation

> Visualization

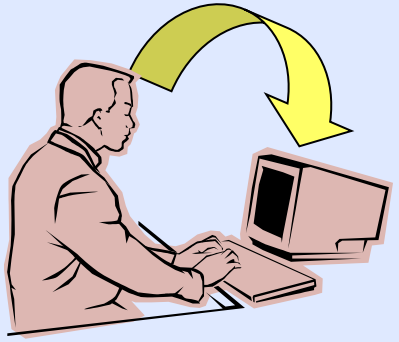
> Support the human decision process

- Information Products
- Resource Status

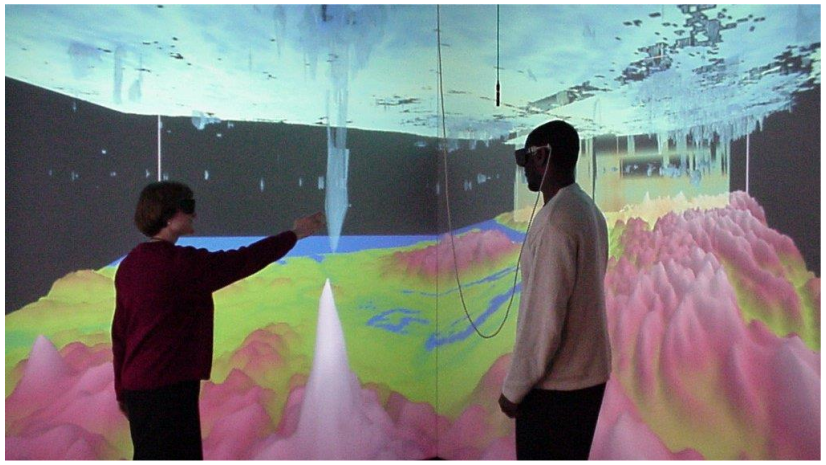
2. Human-in-the-Loop Data Fusion

> Combine human and machine products

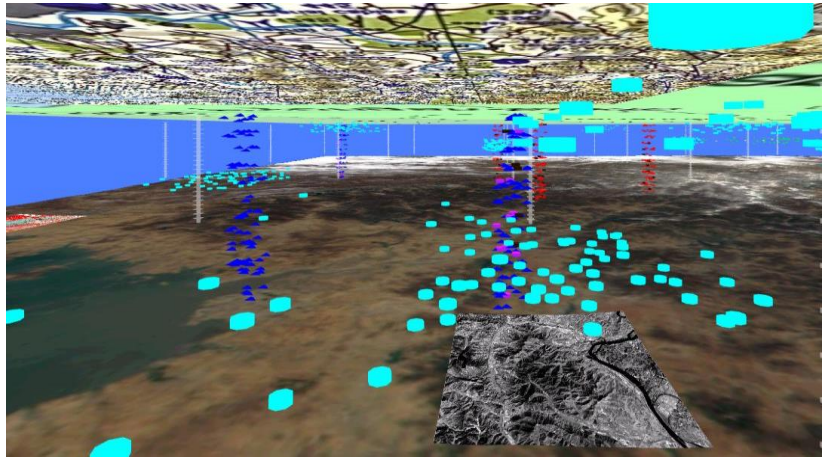
- Information Products
- Resource Controls



Advanced Displays/HCI



3-D Immersive Display



Hierarchical Layered 3-D Display

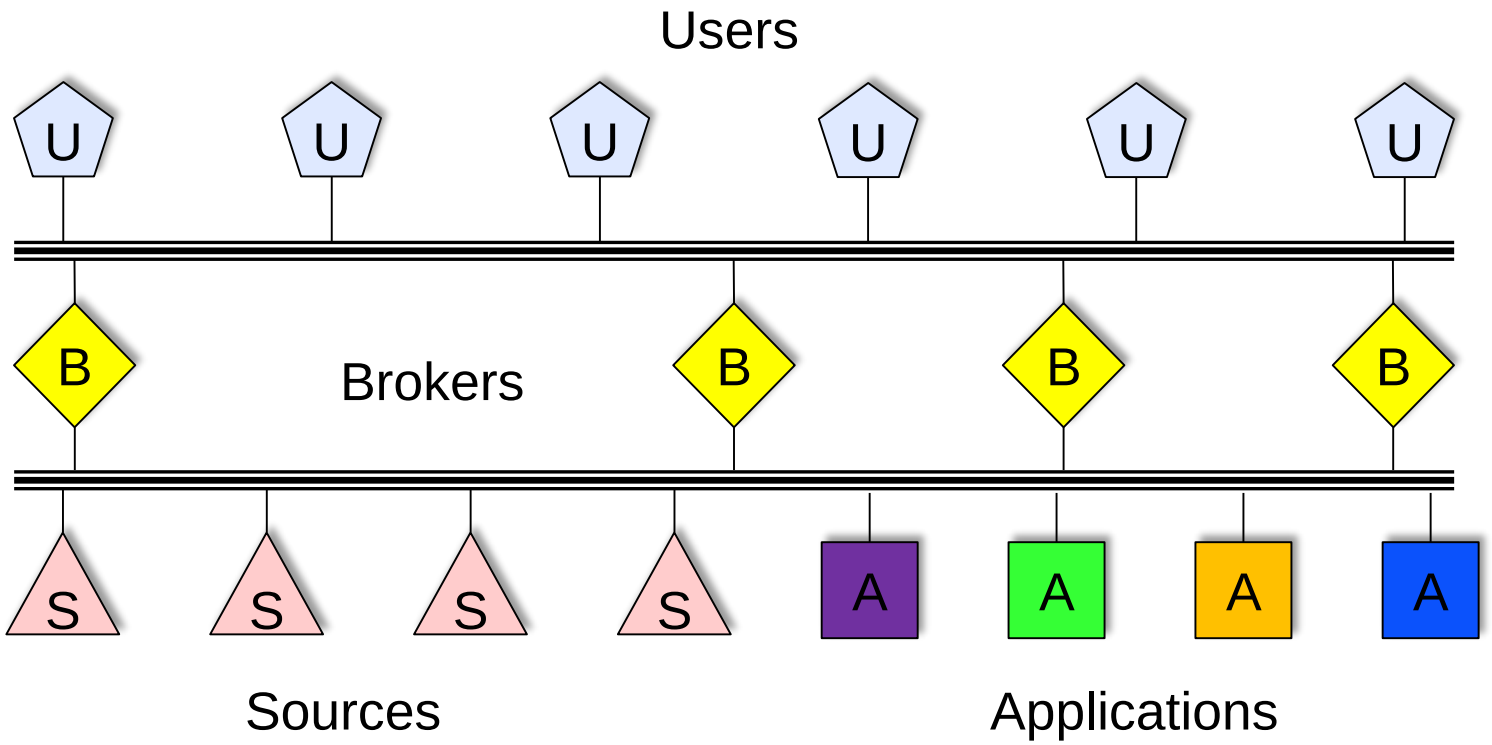
Improved Data Understanding

- > **Contextual sensitivity**
- > **Information discovery**
- > **Multi-expert collaboration**
- > **Visual intelligence for data mining and understanding**
- > **Utilization in an operational environment**

Human-in-the-Loop Fusion Issues

- **"Soft" data**
  - > Semantic extraction from NL and other human-generated data
- **Operator performance model**
  - > Confidence
  - > Competence
  - > General and idiosyncratic biases
- **Goal model (operator & mission)**
  - > Goal decomposition and prioritization
  - > Results composition and dissemination
- **Interactive Tools**
  - > Collaboration tools
  - > Hypothetical and contingency analysis: Gaming

“Agents with Attitude”



Dirty Secrets in Data Fusion Revisited

(Adapted from Hall & Steinberg, 2001)

How to build it?

1. Downstream processing cannot absolve the sins of upstream processing
2. The fused answer may be worse than the best sensor
3. There are no magic algorithms *(yes, even particle filters, random sets, machine learning, cognitive modeling, knowledge discovery, etc., etc.)*
4. There will never be enough training data
5. Giving the “hard” problems to the analysts is not always the thing to do: people can easily be fooled
6. Fusion is not a static process: We’ve started at the wrong end and continue to focus on the wrong end

Dirty Secrets in Data Fusion Revisited

(Adapted from Hall & Steinberg, 2001)

But will it work?

1. No one really knows how to determine the uncertainties in sensor data or in prior intelligence *… second-order garbage in/second-order garbage out*

2. Many big things in life aren't predictable: *for these "recognition" techniques will not work*

3. It is difficult to quantify the value of a complex fusion system, much less predict it *…so who'd want to buy one or trust their lives to one?*

4. The standard performance measure for target recognition is operationally useless: *Prob of correct ID* $p(\hat{x}|x)$ *vs Reporting accuracy* $p(x|\hat{x})$

5. We are happy to learn from our successes, but we bury our failures: *whatever happened to "lessons learned"?*

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