Evaluating Models of Human Performance:
Safety-Critical Applications

Michael Feary
HSS Technical Lead

HFES Annual Meeting
May 24, 2012
Human Performance Modeling in Safety-Critical, Mixed-Initiative Domains

- Focusing on evaluations of acceptability as well as optimality
- Need to account for distributions of behavior
- Tasks as the linkage for complex system evaluation
- Increased use of automation emphasizes need for evaluation of attention
Cognitive Modeling for Safety Critical, Mixed-Initiative Applications

• Supporting Tradeoff Decisions
  - Social Penetration: Characterizing the problem space
    • Focus on evaluating the correct questions
  - Metricity: Avoiding the Illusion of precision
    • Applicability, Uncertainty
  - Robustness: Defining strategic variation
  - Data Applicability: Identifying the measurement needs
Limitations: Bridging the Granularity Gap

- New architectures
  - Bounded Optimality – focus on the problems the human has
  - Strategy Generation – focus on how goals could be achieved, strategic variation

Multi-tasking Strategy Space Analysis

(Brumby, Howes, Salvucci, 2007)
Limitations: Bridging the Granularity Gap

- New Tools for Domain Experts
  - CogTool
- New empirical measures
  - Focus on attention
  - eye tracking
  - fnirs images
  - EEG

CogTool (John et al., 2004)
SanLab, Gray
Portable fNIRS
Thank You
## Taxonomy

<table>
<thead>
<tr>
<th>ATTRIBUTE</th>
<th>1 (LEAST)</th>
<th>2 (MODERATE)</th>
<th>3 (MOST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A DATA APPLICABILITY</td>
<td>No basis in existing data</td>
<td>Describes existing data</td>
<td>Predicts future data</td>
</tr>
<tr>
<td>B DIMENSIONALITY</td>
<td>Single input, single output</td>
<td>Multi input, single output</td>
<td>Multi input, multi output</td>
</tr>
<tr>
<td>C METRICITY</td>
<td>Limited to nominal relationships</td>
<td>Primarily ordinal relationships</td>
<td>Entirely cardinal relationships</td>
</tr>
<tr>
<td>D ROBUSTNESS</td>
<td>Unique focus on limited objects or events</td>
<td>Moderate focus to a variety of objects or events</td>
<td>Comprehensive of a wide slice of nature</td>
</tr>
<tr>
<td>E SOCIAL PENETRATION</td>
<td>Confined to a mental model</td>
<td>Communicated to the relevant community</td>
<td>Accepted and used by the relevant community</td>
</tr>
</tbody>
</table>