

Application of Cognitive Agents to NAS Models and Real Time Simulations

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MITRE Sponsored Research



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Problem

- **MITRE is commonly asked determine what impacts new technologies may have on the National Airspace System (NAS).**
- **In order to understand system-wide impacts, it is necessary to understand the effects of a technology on controllers/pilots.**
- **Specifically, what are the effects of new technologies on controller/pilot workload, productivity, and error rates across the NAS?**

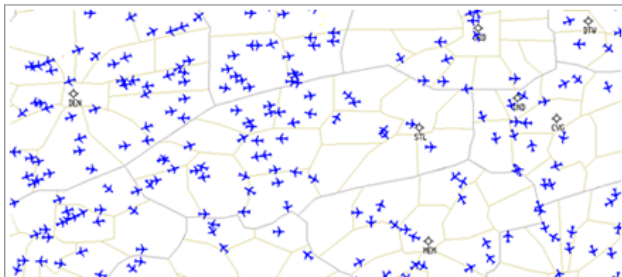
Background

In the past we have implemented a single, static cognitive model that interacts with a constrained environment over a few minutes

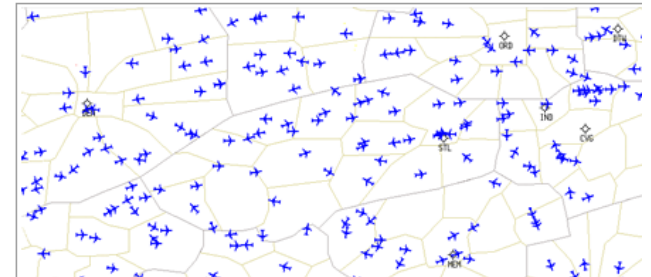


Past Environment

Through this project we are aiming to implement many automated cognitive models that interact with a robust environment (and each other) over several days



2 days



Future Environment

Objective

- **Our objective is the creation of a library of autonomous cognitive models that can be implemented within NAS models or real-time simulations**
 - **During Fiscal Year 2006 a simple cognitive model that interacts with an en route airspace simulation environment will be created as a proof of concept**

Activities

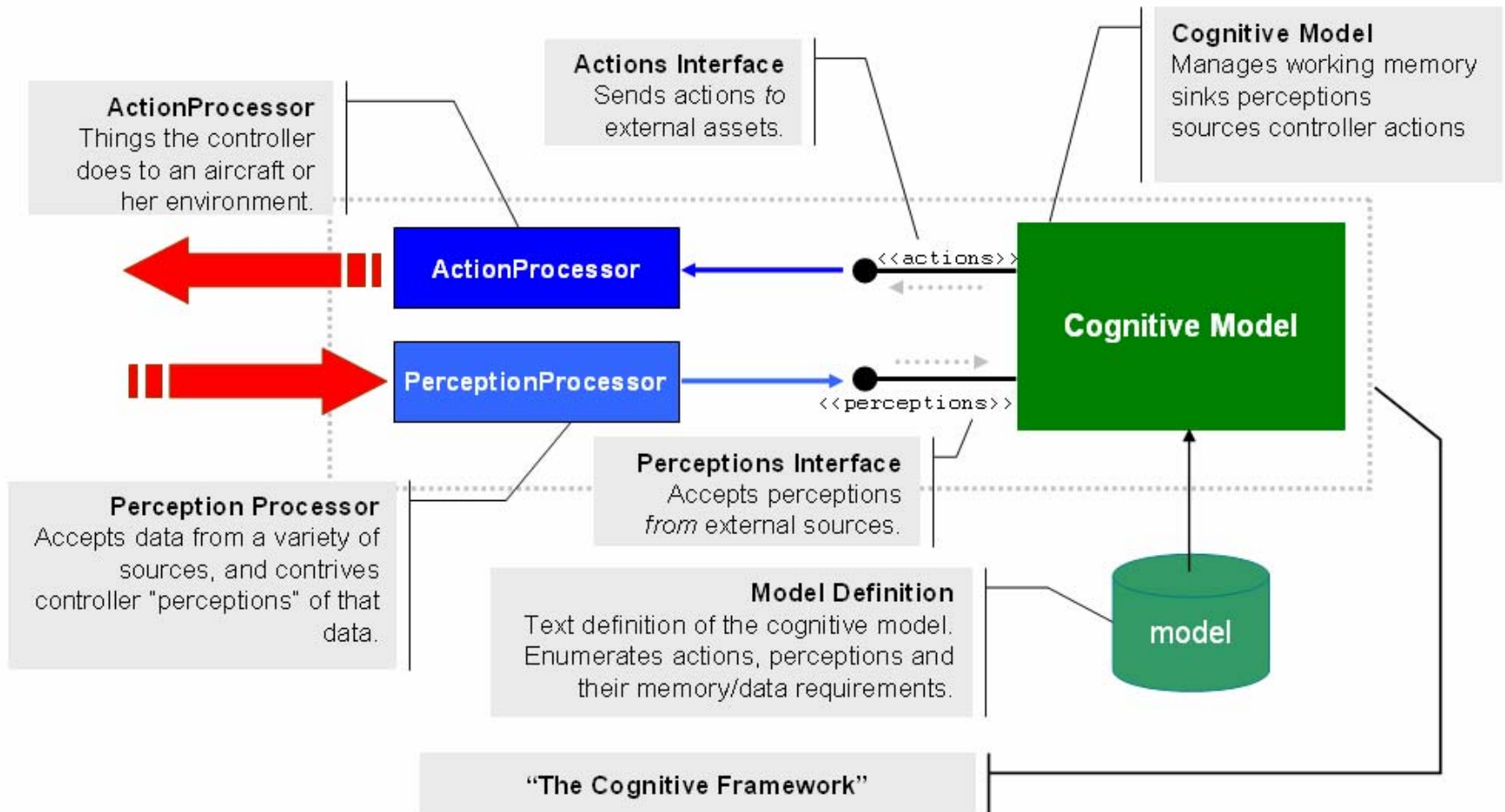
- **Development of user requirements document and cognitive architectures survey**
- **Selection of a cognitive architecture**
- **Development of simple test models**
- **Development of an infrastructure to support communications between cognitive models and simulation environment**
- **Research into skilled working memory for architecture enhancement**

Highlight

Operator	Elapsed Time	Working Memory	
	0.05		Method for Goal: Determine Next Action
MT	1.30	0	Step 1 Scan DSR
M	1.69	0 1	Step 2 Decide IF AC in Position, Accomplish Goal - HO
	1.74	0 1 1	Method for Goal: HO AC to New Sector
	1.79	0 1 1	Step 1 Accomplish Goal: Determine sector
	1.84	0 1 1 1	Method for Goal: Determine New Sector
	1.89	0 1 1 1 1	Step 1 Accomplish Goal: Retrieve Info from DB
	1.94	0 1 1 1 1 1	Method for Goal: Retrieve info from DB
M	2.33	0 1 1 1 1 1 1	Step 1 Scan DB
M	2.72	0 1 1 1 1 1 1	Step 2 Encode CID
M	3.11	0 1 1 1 1 1 1 1	Step 3 Encode Altitude
M	3.50	0 1 1 1 1 1 1 1	Step 4 Encode Heading
M	3.89	0 1 1 1 1 1 1 1 1	Step 5 Verify Correct
	3.94	0 1 1 1 1 1 1 1 1	Step 6 Return with Goal Accomplished
MR	4.49	0 1 1 1 1 1 1 1 1	Step 2 Recall LTM fact - Sector based on altitude
M	4.88	0 1 1 1 1 1 1 1 1	Step 3 Verify Correct
	4.93	0 1 1 1 1 1 1 1 1	Step 4 Return with Goal Accomplished

Excerpt from paper & pencil cognitive model
 which will be used to generate automated
 models

Highlight

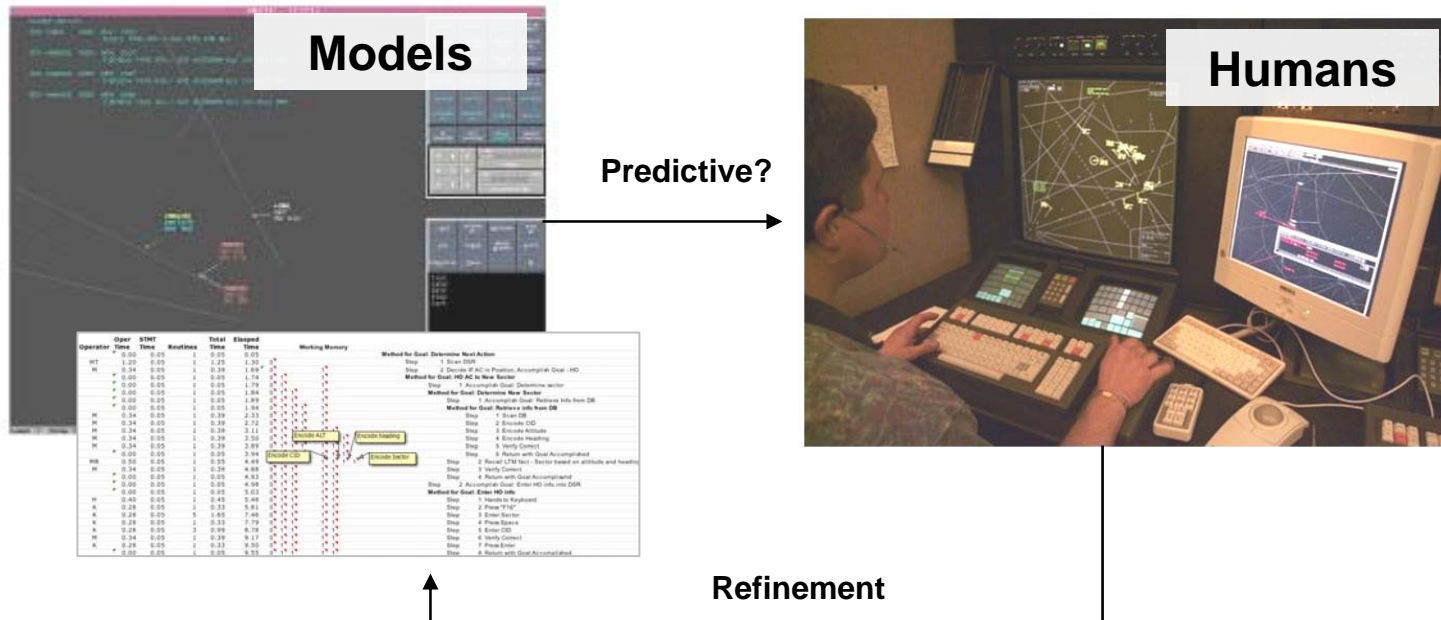


Concept for communications between cognitive models and simulation environment

Impacts

- **Embedded cognitive models will allow for macro-level system results that are based on, among other things, micro-level cognitive data of a type usually gained only in human-in-the-loop (HITL) evaluations.**
- **This information can then be used to predict, for example, whether using automation reduces controller workload to a point where increases in productivity allow controllers to handle additional aircraft or even additional sectors.**
- **Within real-time environments, cognitive agents can facilitate HITL evaluations, acting as pilots, controllers, or traffic managers.**

Future Plans



Validation and refinement through comparison of model performance to human performance