



Using Multiple Personas in Service Robots to Improve Exploration Strategies when Mapping New Environments

www.infotech.monash.edu

Intelligent Environments (and Functional Decomposition?)

- The (distant?) future digital home?

Lighting and other sensors, cameras, fire, movement

Smart, self cleaning windows with automatic shutters



Washing Machine

Smart cooker



Where are robots in this picture?

- Isaac Asimov famously described a future where humanoid robots played an integral part in our lives



Robots to water the plants and sweep the floor



Robot serving a cup of nice hot tea

Perception

- **Cognitive Science: A process for acquiring, interpreting, selecting and organising sensory information**
- **Two significant approaches to incorporating perceptions into robot controllers**
 - Reactive architectures
 - Deliberative architectures, rich semantics

Multiple Personas

- **Philosophy and Psychoanalysis**
 - One explanation for irrationality
 - Functional splitting
- **Splitting for functionally sound reasons**
 - Possible aide to robust and efficient operation within a variety of different contexts
- **Interested in exploration and curiosity**

Environmental Maps




- **Maps can help robots to operate effectively and efficiently**
- **Digital homes can be very complex areas to map, with numerous items densely packed into geometrically varied spaces**
- **Developed a perceptions based mapping model to deal with such environments**

Navigational Hierarchy

Perceptual Survey Maps

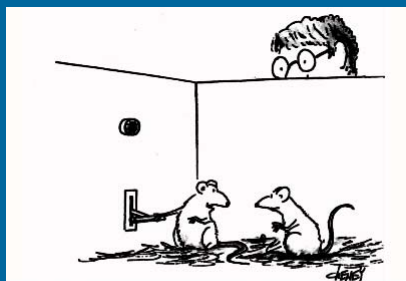
Spatial Process	Behavioral Prerequisite	Navigation Competence
Survey Navigation	Embedding into a common reference frame	Finding paths over novel terrain
Topological Navigation	Route integration, route planning	Flexible concatenation of route segments
Recognition Triggered-Response	Association sensory pattern - action	Following fixed routes
Guidance	Attain spatial relation to the surrounding objects	Finding a goal defined by its relation to the surroundings
Aiming	Keep goal in front	Finding a salient goal from a catchment area
Direction Following	Align course with local direction	Finding the goal from one direction
Search	Goal recognition	Finding the goal without active goal orientation

Classification: Spatial Integration (Geocentric, Egocentric), Global Navigation, Local Navigation




7

Biological foundations

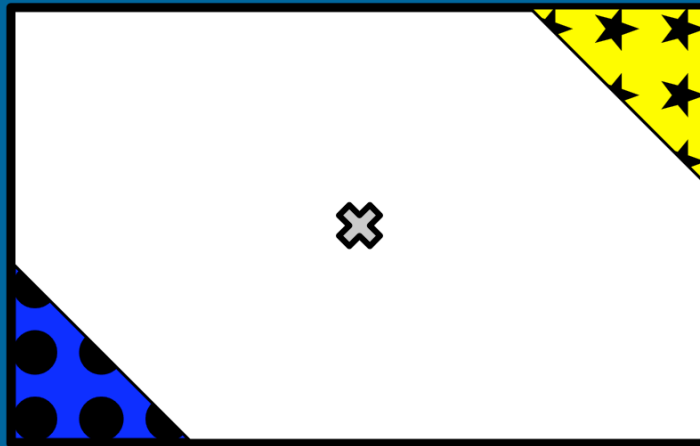
- What do these mammals all have in common?



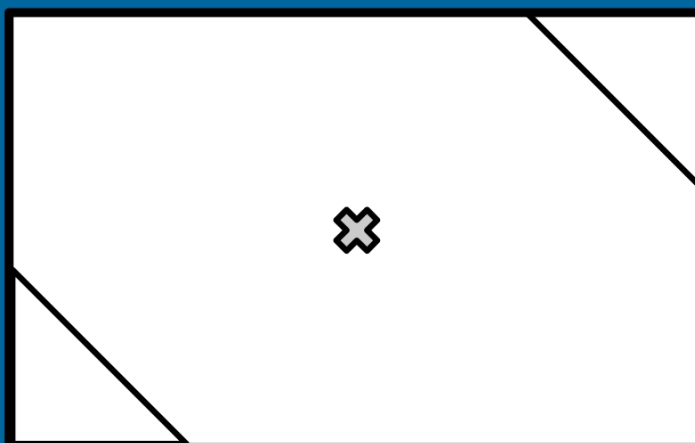
It's a rather interesting phenomenon. Every time I press this lever, that post-graduate student breathes a sigh of relief.



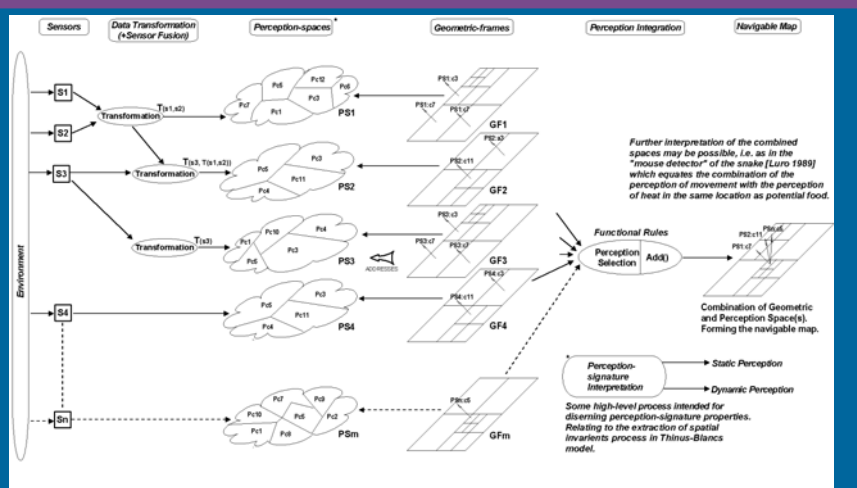
A Working Memory Experiment (1)



A Working Memory Experiment (2)



The Perceptual Mapping Model



Perceptual Space

- Initial experiments used low level sensor data to characterise place areas
 - Brittle, not very robust
- Next phase, use semantic rich place descriptions
 - One possible method, attempt to recover descriptions from vision sensor, not easy!
 - Employ the characteristics of a smart home?

Geometric Space

- **Initial experiments used odometric information derived from wheel encoders**
 - Not very robust over large areas
- **Next phase, employ characteristics of smart home?**
 - Actively define boundaries and maintain position using sensor data
 - Semantic SLAM?

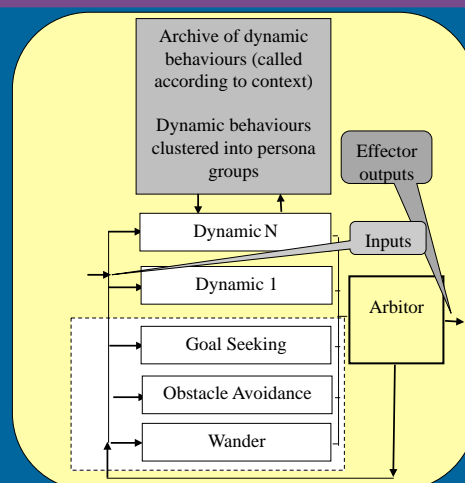
Exploration

- **Where the robot has no *a-priori* knowledge**
 - Currently exploration considered as a random wonder
 - Naïve guidance can be given simply by expanding outer edges of geometric space
 - Not very efficient methods
- **But what about,**
 - Emotionally or persona guided exploration?
 - Curiosity?

The control Model (1)

- **A behaviour based architecture**
 - manages the creation, adaptation and termination of behaviours
 - Introducing a persistent experience based evolving control model of the world
- **Architecture utilises fuzzy logic and genetic system principles**

The control Model (2)



The Persona Model (1)

- **Irrationality**
 - Like being controlled by two different controllers cued by context
 - No higher level control system to mediate
- **Achieve role specific specialisation**
 - Efficiently partition the problem space
 - Behaviours or contexts?

The Persona Model (2)

- **Research**
 - To explore the hypothesis that personas guide our actions
 - > i.e. we are not reactive agents that simply act on the immediate sensing of the world
 - Making decisions occasionally overrides the logical nature of the world, akin to irrationality

Summary

- **A novel perceptual survey mapping model**
 - Well suited to digital homes
- **Notion of extending this model with persistent experiences**
 - In the form of multiple personas
- **Work at early stages**
 - Might cast light on to how our own mind works, and might lead to improved service robots in future digital homes



MONASH University
Information Technology



University of Essex

Department of
Computing and
Electronic Systems

19