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An Application of CoSMoS Design Methods to Pedestrian Simulation

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Introduction

- Pedestrian modelling
- Experiences with using JCSP
- Employing the CoSMoS design method
  (... and getting it wrong)
- Simulation

Pedestrian modelling

- ... is difficult
- Is done at many levels of scale
- Can be (but usually isn't) data driven
- Our approach to the problem is:
  - At a relatively small scale
  - Data driven

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Experiences of using JCSP

- Watching Walkers exhibit at 2006 Edinburgh Science Festival
  - 5000 visitors to exhibit
  - System performed incredibly robustly
  - LOC < 3000
- Data collection
  - Six infrared detectors deployed in corridor
  - Read concurrently in real-time
  - Unattended, automated operation
  - More data than we know what to do with
- Simulation
  - Robust framework to build on
  - Deadlock, livelock, race hazard free
  - No thread programming

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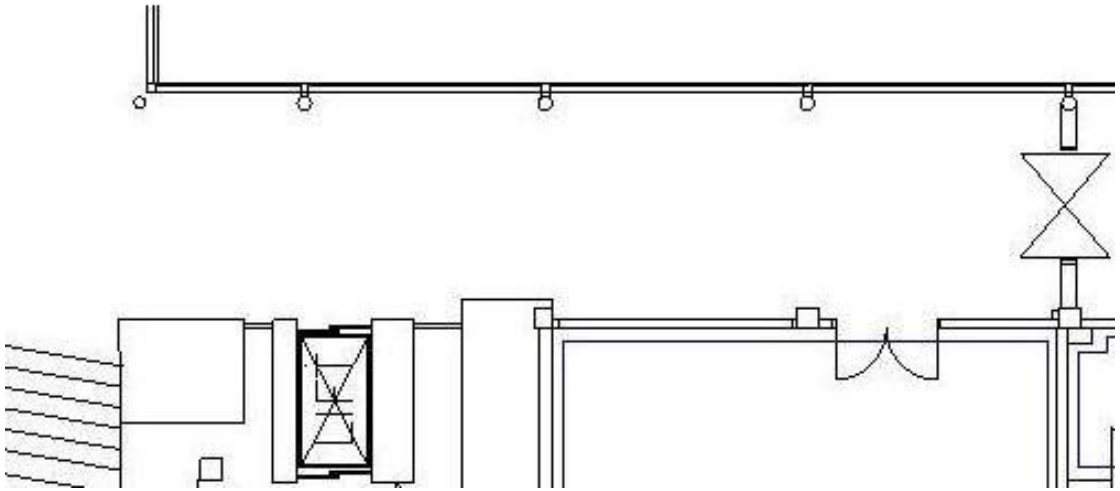
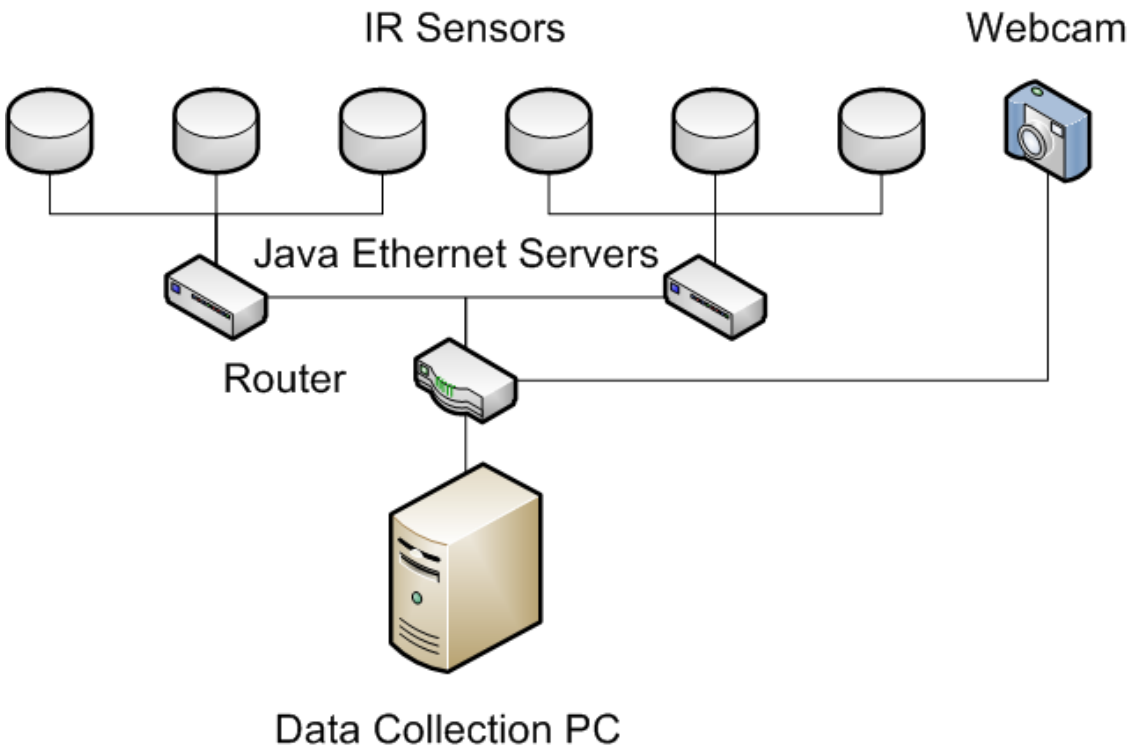
Experimental Area

Experimental Area




IR Sensors
Webcam
Java Ethernet Servers
Router
Data Collection PC

CoSMoS design method

- What they are
- How I got it wrong
- Good results nonetheless
- Matters of scale

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CoSMoS design method

- Built around phased synchronisation on barriers
- Combines this with the use of client server architecture
- Both proven to be error free, if used correctly

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Example Code - Barriers

```
public class Agent implements CSProcess {
    private Barrier discover;
    private Barrier modify;

    public Agent {
         discover.enroll();
         modify.enroll();
    }

    public void run() {
         while(true) {
                  discover.sync();
                  discover();
                  modify.sync();
                  modify();
         }
    }
}
```

Example Code – Client/Server

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Client

```
private ChannelOutput request;
private AltingChannelInput response;

...

request.write(Request.DISCOVER);


Info info = (Info) response.read();

...
```

Server

```
private AltingChannelInput request;
private ChannelOutput response;

...

Request r = (Request)request.read();
switch(r) {
   case Request.DISCOVER:
        response.write(discover());
        break;
...
}
```

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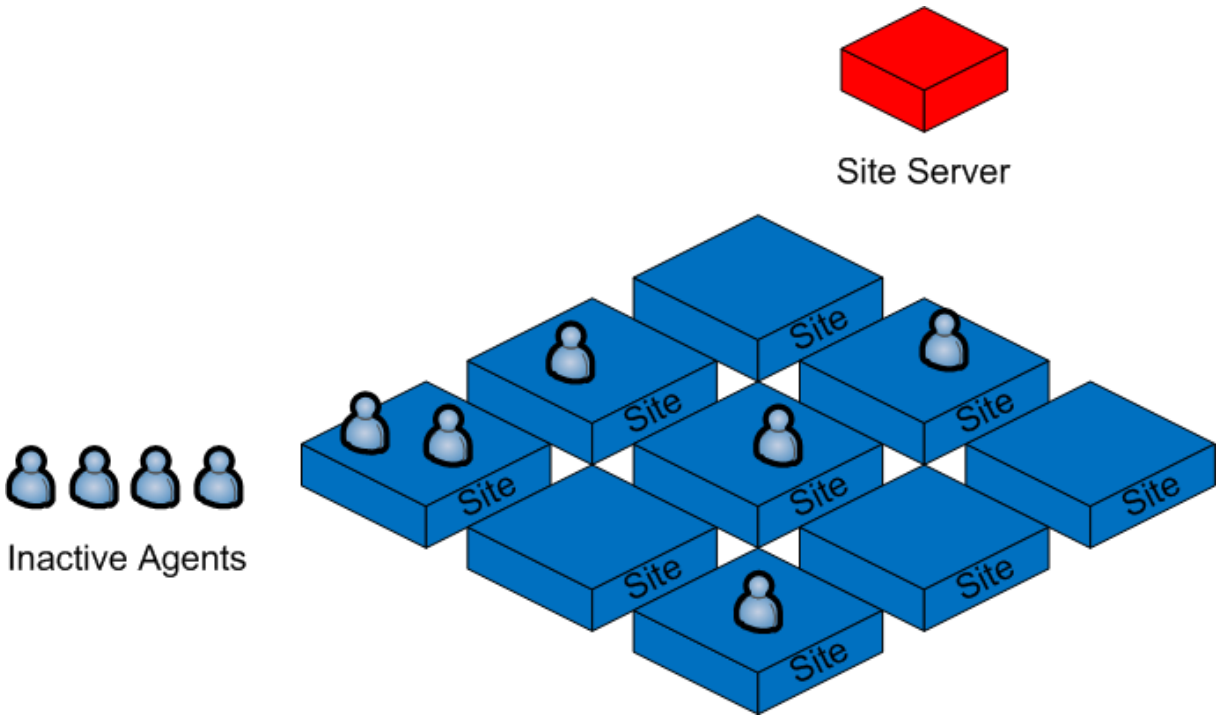
How I got it wrong



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How I got it wrong

Agent		Site		Site Server
		Synchronise on discover barrier		
		Request global coordinates	→	Receive requests
		Receive global coordinates	←	Send global coordinates
Request update	→	Receive requests		
Receive update	←	Send global coordinates		
		Synchronise on modify barrier		
Modify state				
Send state	→	Receive state		
Receive ACK	←	Send ACK		
		Send updates	→	Receive updates
		Receive ACK	←	Send ACK
				Aggregate updates into global coordinates

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Processes that express space are functionally and conceptually separate from time contingent processes

(i.e. Don’t engage in barrier synchronisation)

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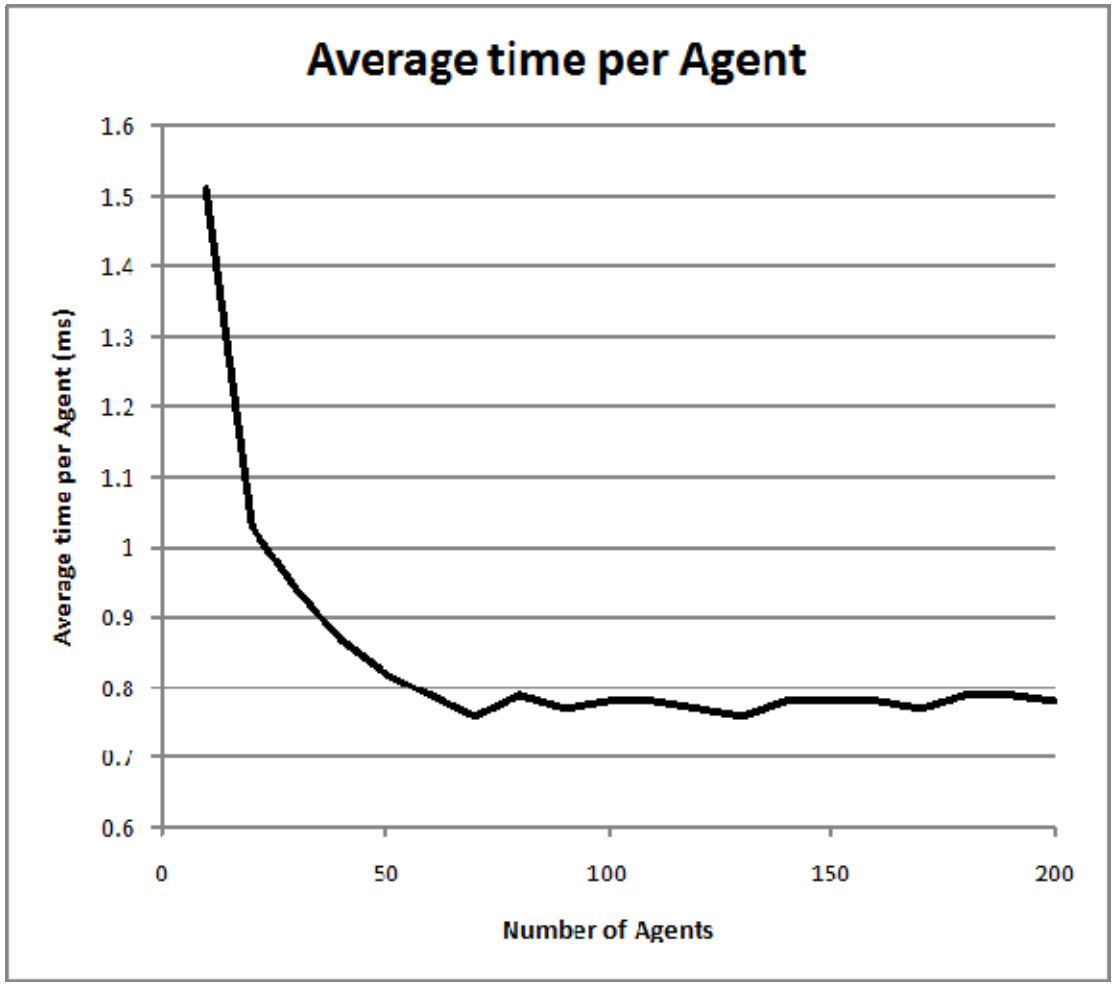
Good results nonetheless



Matters of scale

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CoSMoS

- Millions of processes
- Macroscopic scale
- Built on occam
- Low process overhead

Pedestrian Model

- Tens of processes
- Microscopic scale
- Built on JCSP
- High process overhead

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Examples

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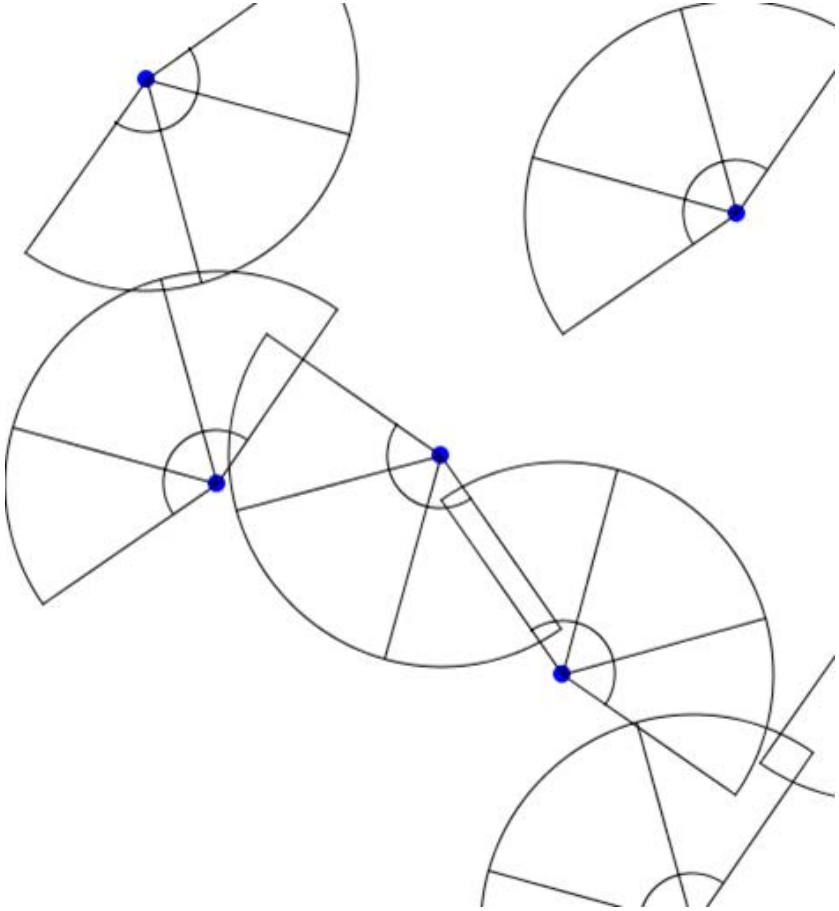

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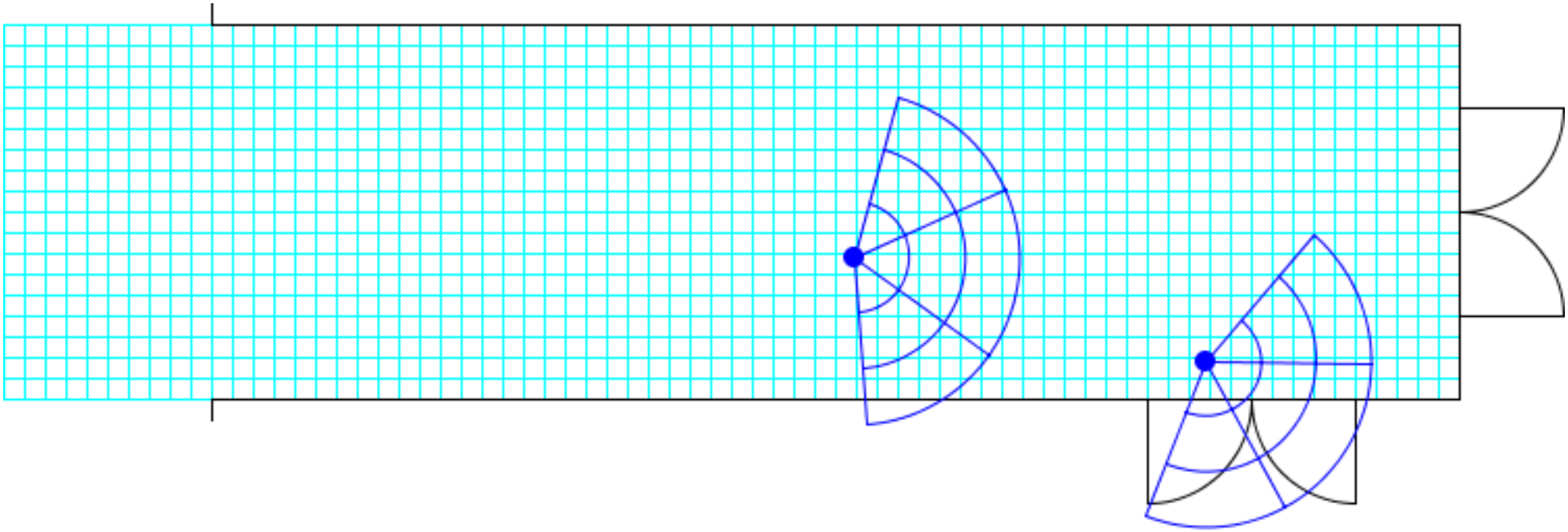

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Conclusion

- Utility of JCSP and CoSMoS
  - Significantly reduced development time
  - Less error prone
  - More functionality for less code

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Future Work

- Building a Learning Classifier System to extract behavioural parameters from the observed trajectories.
- Particular focus on collision avoidance.
- Building a model to enable analysis of built environment, based on real, observed parameters.

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Thank You