



Research Consortium in Speckled Computing

Research Overview

D.K. Arvind

Director

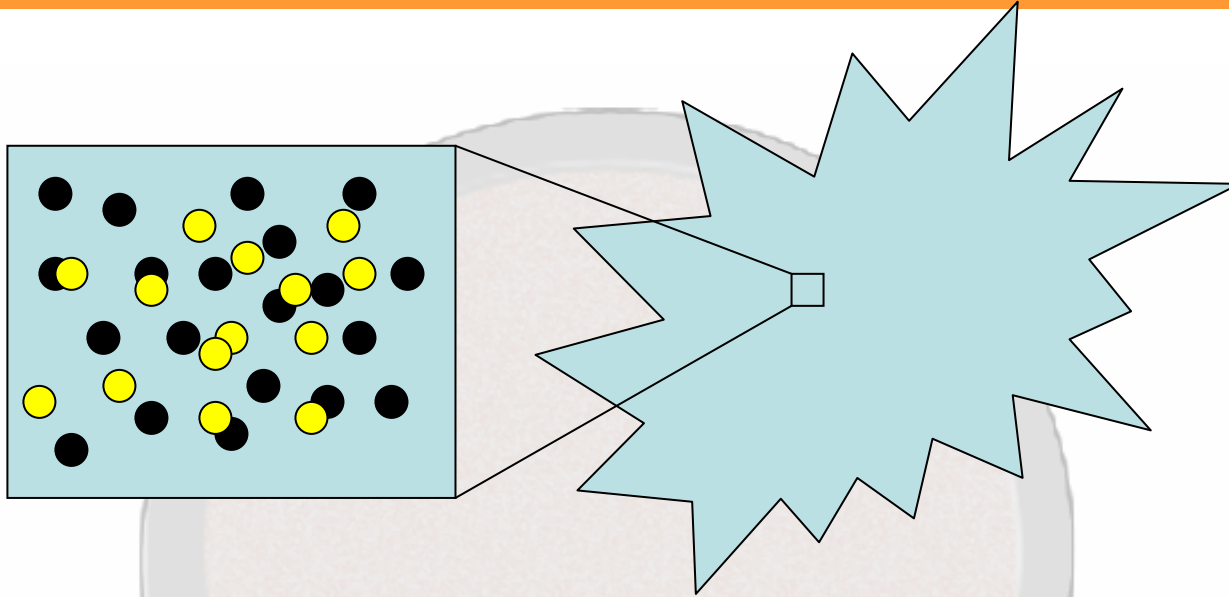
Research Consortium in Speckled Computing
School of Informatics, University of Edinburgh

(dka@inf.ed.ac.uk)

6th Workshop, 11th September, 2007

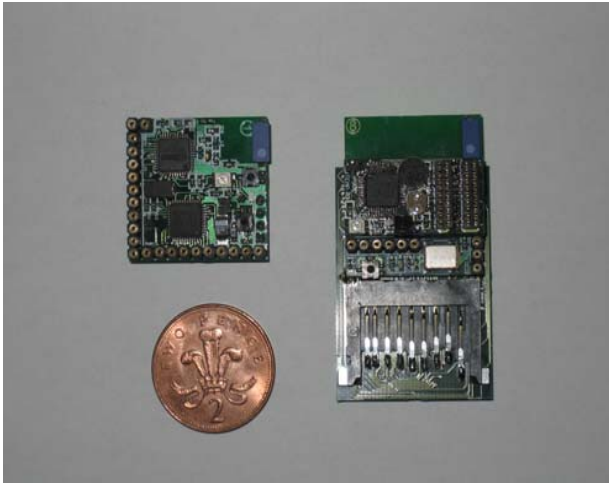


"Specks are programmable semiconductor devices which can sense, compute, and network wirelessly."

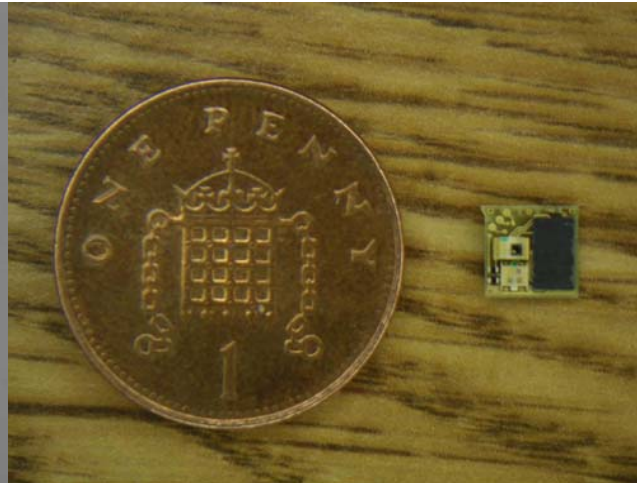


- Specks communicate **wirelessly**
- Battery powered with energy scavenging in the future
- Specks are assumed to be **non-static** and **unreliable**

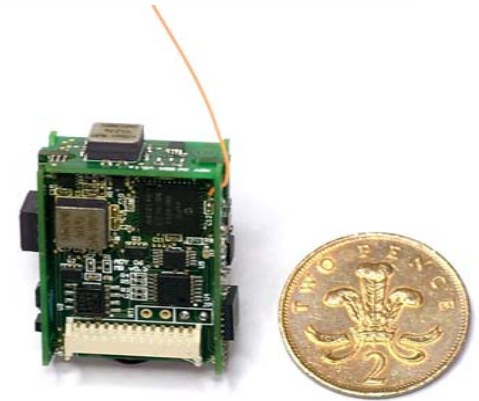
Specks



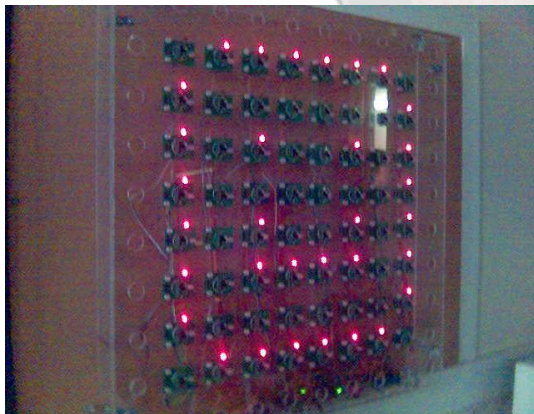
Prospeckz platform



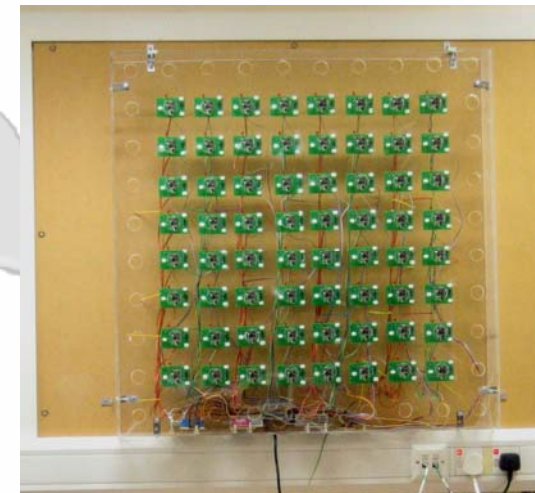
5-Cube OTS



Orient2 platform

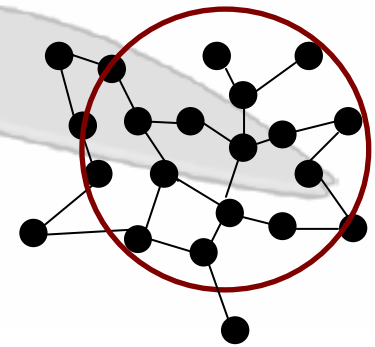
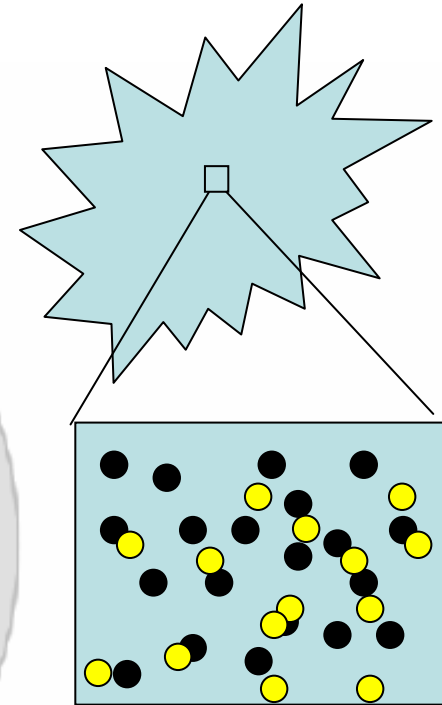


64-node Perspeckz Test-bed



Specknets

- Tens of specks collaborate as dense **programmable network** – Specknet
- Sensory data processed collaboratively, and information extracted *in situ* – fine-grained distributed computation
- Encapsulation of sensing, processing and wireless networking in a single device - new class of Information Processing Devices



Enabler Technology for Ubiquitous Computing

SpeckSim Behavioural Simulation Environment

The screenshot displays the SpeckSim software interface. The main window shows a 3D visualization of a network simulation with numerous grey cube-shaped nodes connected by blue lines. A single node on the right is highlighted in red. The interface includes several control panels:

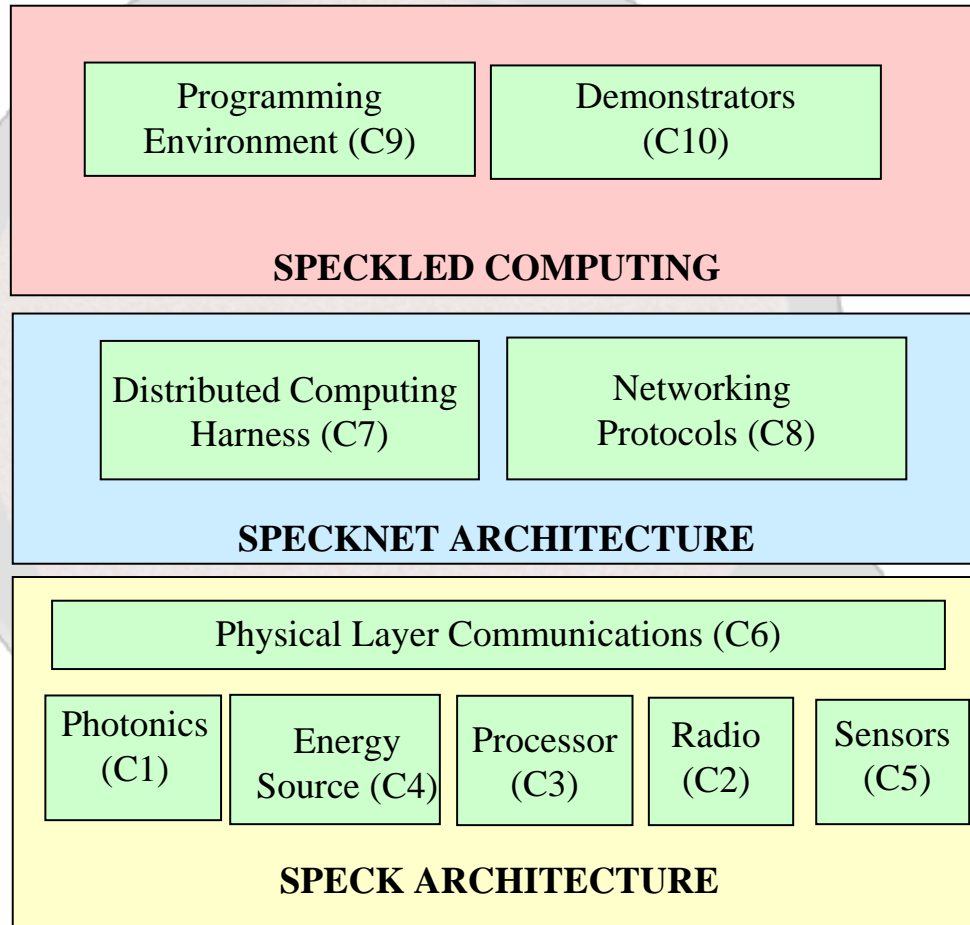
- SpeckSim**: Main menu with options like Speck populations, Movement Models, Walls, State filters, and State processors.
- Speck populations**: Panel for Resident flavours and adding elements.
- Direction sense speck**: Panel for Ellipsoid shell, Broadcast Delay, Record Lifetime, Precision, Transmission Range, Angle sense error, Angle sense quantisation, Number of beacons, Random beacon distribution, 2D Beacon distribution, and RNG seed offset.
- Statistics**: Panel for History length (300) and a tree view of statistics including Communications, Distance Estimation, Leaders, Location, Located Specks, Raw Error, Corrected Error, Unfiltered, Location-based routing, and Neighbourhood.
- Location Renderer**: Panel with checkboxes for Location, Neighbourhood, and Speck Renderers.
- Interface options**: Panel for Update Frequency, GLVisualiser, and Speck visualiser.
- Neighbourhood Ren...**: Panel for Edge Width, Length Offset, Subdivisions, Edge material, and Symmetric edge material.

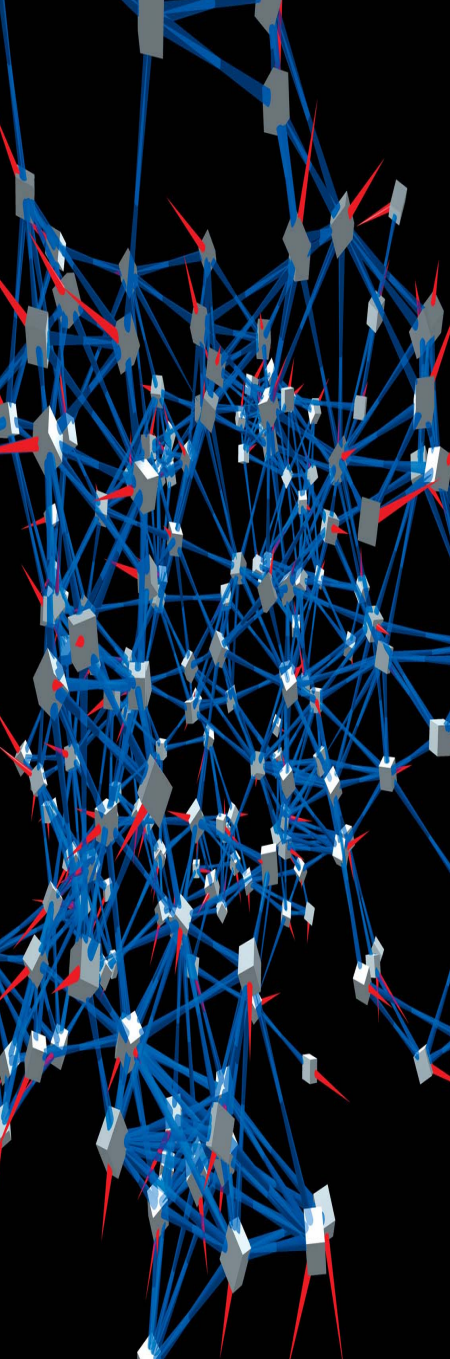
The bottom status bar shows: Simulation performance: 0.0 | Simulation time: 17.200 | Run | Step | 0.1 | Reset

Log output at the bottom of the main window:

```
22/10/06,17:22:6.262, Source: "Simulator system": Speck flavour "Direction Sense Speck" registered":  
22/10/06,17:22:6.267, Source: "Simulator system": Speck flavour "Noisy Range Speck" registered":  
22/10/06,17:22:6.269, Source: "Simulator system": Statistics module "LeaderStatisticModule" registered":  
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22/10/06,17:22:6.522, Source: "Simulator system": Speck flavour "Location Skew Speck" registered":  
22/10/06,17:22:6.522, Source: "Simulator system": Speck flavour "Velocity Speck" registered":  
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22/10/06,17:22:6.528, Source: "Simulator system": Movement Model "Waypoint" registered":  
22/10/06,17:22:6.551, Source: "Simulator system": Movement Model "Excited Henge Model" registered":  
22/10/06,17:22:6.554, Source: "Simulator system": Movement Model "PerSpecks Model" registered":  
22/10/06,17:22:6.556, Source: "Simulator system": Movement Model "Grid Model" registered":  
22/10/06,17:22:6.556, Source: "Simulator system": Statistics module "NeighbourhoodModule" registered":  
22/10/06,17:22:6.557, Source: "Simulator system": Statistics module "LocationModule" registered":  
22/10/06,17:22:6.557, Source: "Simulator system": Statistics module "CommunicationModule" registered":
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Collaborative Technology Push



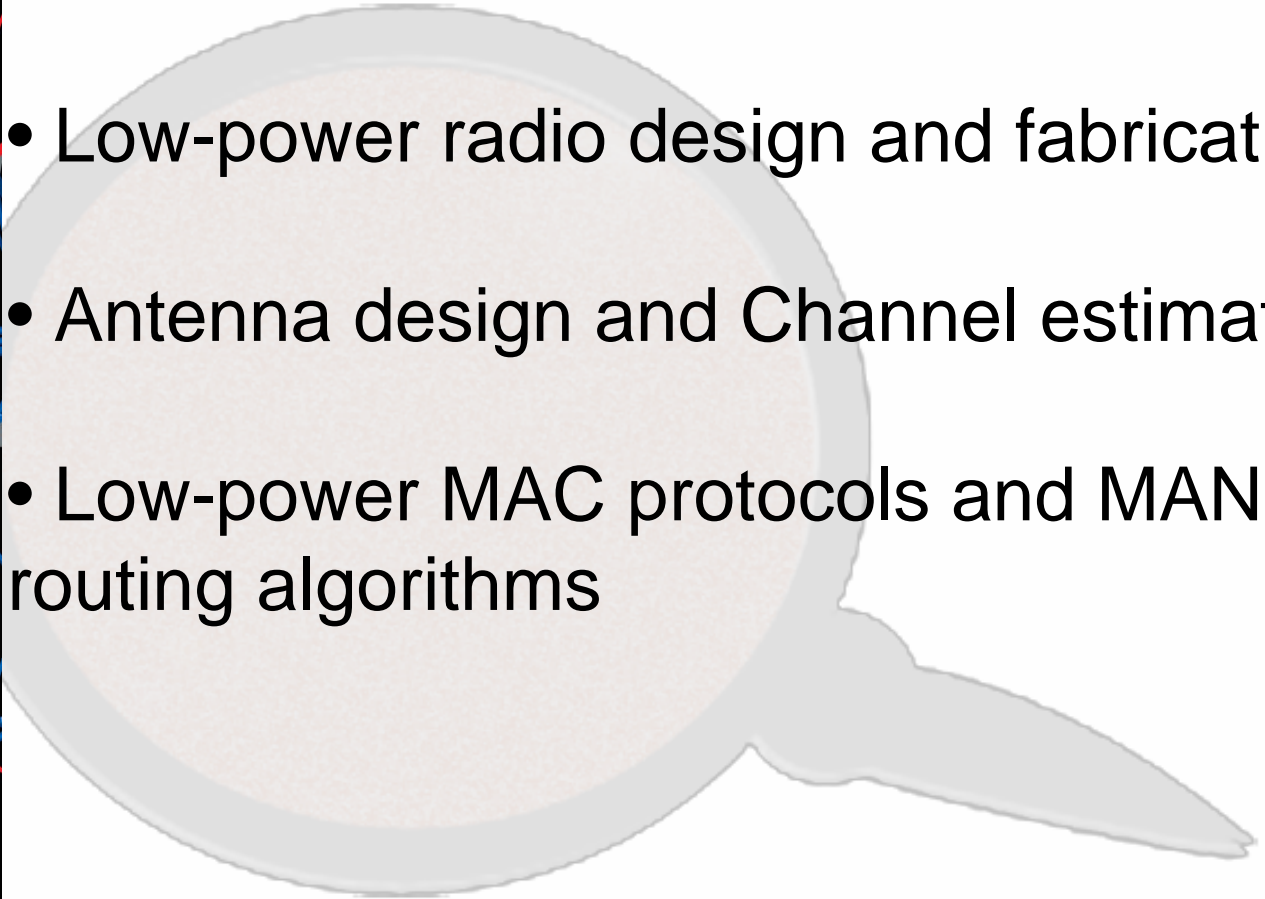


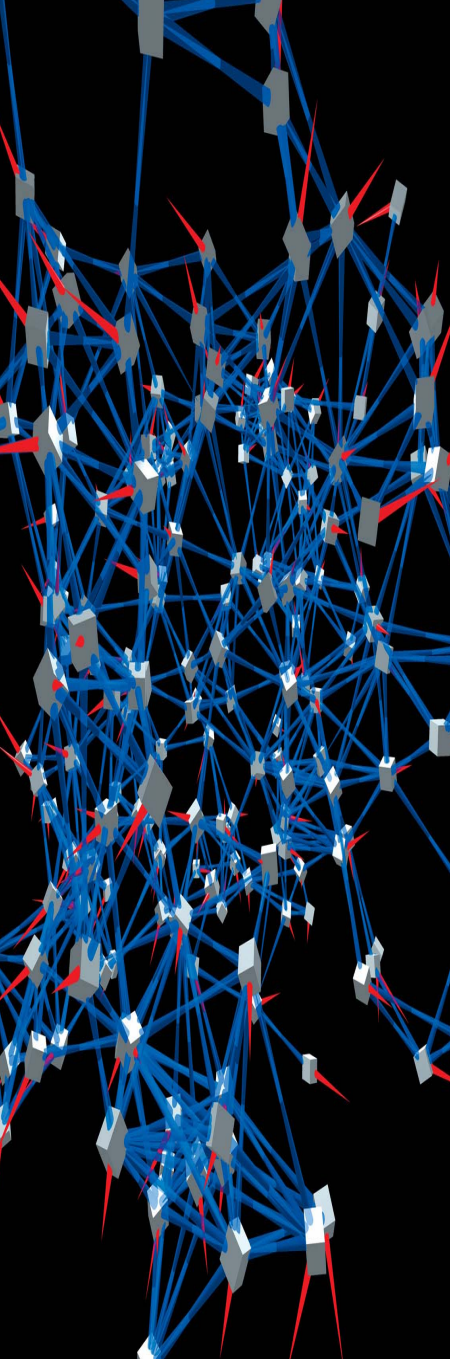
Free-space Optics

- Free-space Optical Communication
- Localisation using Optical means
- Physical layer design



Energy-conscious Design

- Low-power radio design and fabrication
 - Antenna design and Channel estimation
 - Low-power MAC protocols and MANET routing algorithms
- 



Energy Scavenging and Storage

- Towards III-Vs on GoI (photovoltaics tuned to internal lighting)
- Li-Ion Batteries
- Towards energy-neutral platforms



Orient-2 Platform for Wireless Motion Tracking

- Design and Implementation
- Communication protocols
- FFT-based Data Extraction
- Telerobotics

Distributed Algorithms

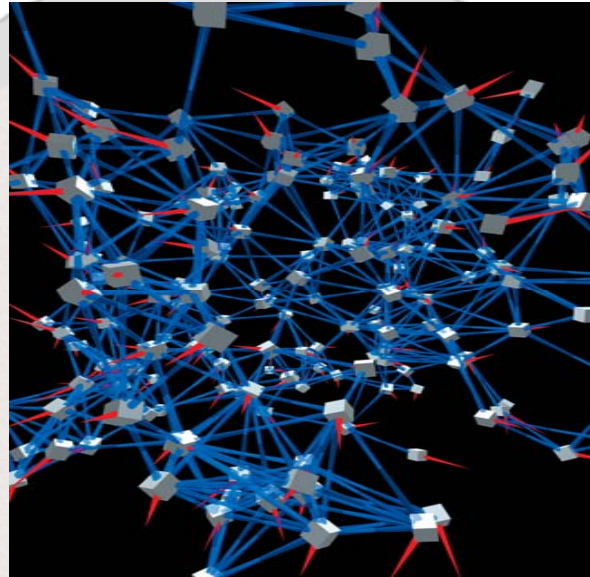
- Location Discovery
- Clustering
- Emergency Evacuation
- Communication protocols with 2-hop interference prevention
- Immune-inspired approaches

Applications

Enhancing Active Play in pre-school children

Early diagnosis in infants

**Gait
Analysis**



**Speckled
Golfer**

Animation and Visualisation Safe Navigation in Built
Environments

Seal2Seal

Music from gestures

Speck-Robots