Real-time analysis of Correlations between On-Body Sensor Nodes

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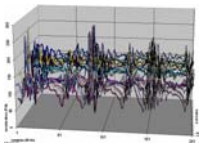
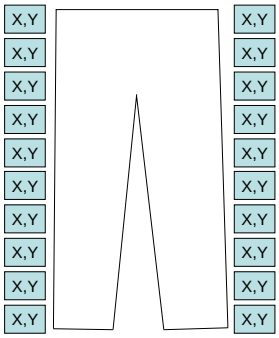
Scenario: Massive Body Sensing Networks

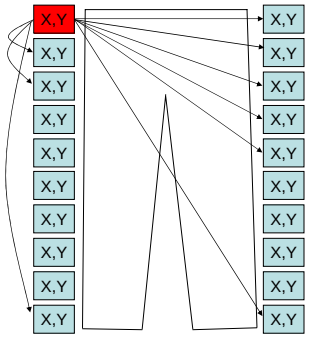
- Clothing:
  - huge surface
  - close to user
  - Textile sensors for stretch, pressure, deformation
  - flexible PCBs, …
- Problems:
  - Curse of Dimensionality
    - Many sensors, slow learning
    - Few sensors, fast learning
  - Bus/Wireless Communication
    - Where are sensors?
    - How are they grouped?



Visualisation of Correlation

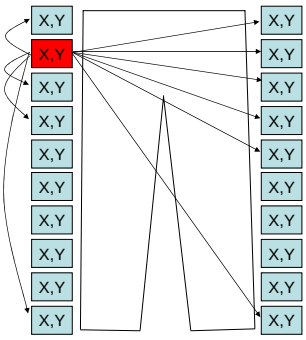


Visualisation of Correlation



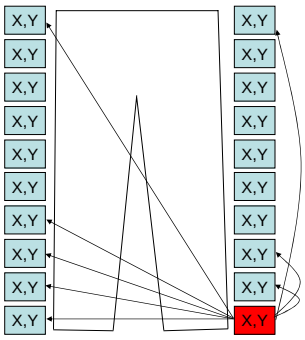
$C1=(c_{1,1},c_{1,2},..,c_{1,20})$

Visualisation of Correlation



$C1=(c_{1,1},c_{1,2},..,c_{1,20})$
$C2=(c_{2,1},c_{2,2},..,c_{2,20})$

Visualisation of Correlation



$C1=(c_{1,1},c_{1,2},..,c_{1,20})$
$C2=(c_{2,1},c_{2,2},..,c_{2,20})$

$C20=(c_{20,1},c_{20,2},..,c_{20,20})$

Visualisation of Correlation

$C1=(c_{1,1},c_{1,2},..,c_{1,20})$
$C2=(c_{2,1},c_{2,2},..,c_{2,20})$

ICA

$C20=(c_{20,1},c_{20,2},..,c_{20,20})$

REALTIME Visualisation of Correlation

$C1=(c_{1,1},c_{1,2},..,c_{1,20})$
$C2=(c_{2,1},c_{2,2},..,c_{2,20})$

Kohonen SOM

GNG

$C20=(c_{20,1},c_{20,2},..,c_{20,20})$

Kohonen Self-Organising Map

- Firm grid
- Neighbourhood relations
- Adaptable neurons
- Neurons' code book vectors adapt to input data
- Nearest neuron to input data is "winner" neuron
- Data gets distributed over map in decreasing influence from "winner" neuron

QuickTime™ and a TIFF (LZW) decompressor are needed to see this picture.

Growing Neural Gas

- Dynamic grid
- Neighbourhood relations via edges
- Adaptable neurons
- Neurons' code book vectors adapt to input data
- Closest and second closest get connected and neighbours moved towards input vector
- Dynamic number of edges and nodes

QuickTime™ and a TIFF (LZW) decompressor are needed to see this picture.

Kohonen Self-Organising Map

- Test with data set for each sensor node as reference
- Counting of "winners" for each data set
- Connection of mostly overall "winners" per sensor node according to position on trousers

QuickTime™ and a TIFF (LZW) decompressor are needed to see this picture.

Growing Neural Gas

- KSOM output builds input of GNG:
  - For each input in the KSOM, the winning neuron is recorded
  - Winning neuron's position in grid builds 2D input for the GNG
- Size of GNG limited

To get a map where each neuron represents a sensor node on the trousers, the amount of neurons was limited to 20

QuickTime™ and a TIFF (LZW) decompressor are needed to see this picture.

And Finally..

- Results:

QuickTime™ and a TIFF (LZW) decompressor are needed to see this picture.

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- Assumptions / remarks:
  - Signals need to fluctuate
  - Sensors do not have to be calibrated..
  - but do need to have 'compatible' signals
  - Plenty of room for further experiments:
    - Allow more neurons for GNG
    - Kmeans clustering
    - …