Computational Intelligence Group

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Definition of the group

- It is a universitary group
  - Core of the group: 10 doctors
  - Loosely coupled research interests and interactions
    - Extremely difficult to stablish a long term research plan
    - Extremely fluid and dynamic
- It has been awarded fund for 6 years by the Basque Government as "Grupo A"

Definition of the group

- Actual composition
  - 10 doctors (professors at the university)
  - 12 non doctor (assistant professors)
  - 8 PhD granted students (4 finishing soon)
  - 4 external collaborators (PhD students at research centers)

Definition of the group

- Swarm research group
  - Quite independent agents
  - Following patterns of behavior with a loose supervision
  - Emerging interesting global patterns (of research and results)
- The leader's role ??

Definition of the group

- Research background: Computational intelligence

  - Artificial Neural Networks

  - Evolutionary Algorithms

  - New ways to perform classification and regression

  - Lattice computing (a personal issue)

Research interests

- Non-linear dynamic systems
- Mobile robotics
- Remote sensing images
- Medical Image processing
- Human computer interaction
- Miscelaneous: watermarking, swarm intelligence….

Non linear dynamic systems

- Historically we have been interested in non linear system modelling
  - Forrester's System Dynamics
  - Socio-economical systems
  - Ecological systems
 - Biological systems (recent PhD)

Non linear dynamic systems

- Non linearity $\rightarrow$ (Deterministic) Chaos
- Recent research works
  - Synchronization of chaotic systems
  - Energy comsumption of synchronization
  - Trend of interest in modelling chaotic biological systems
    - Epilepsy: trouble when a chaotic regime becomes regularly periodic

Mobile robots

- Vision based guidance and navigation
- Simultaneous mapping and localization (SLAM)
    - Non metric:
    - Metric (using 3D cameras…)
- Multirobot systems
    - Linked Multirobot systems: hose transportation

robot(1)
00: Advancing

robot(2)
1: Stretching 0

robot(3)
0.74: Stretching
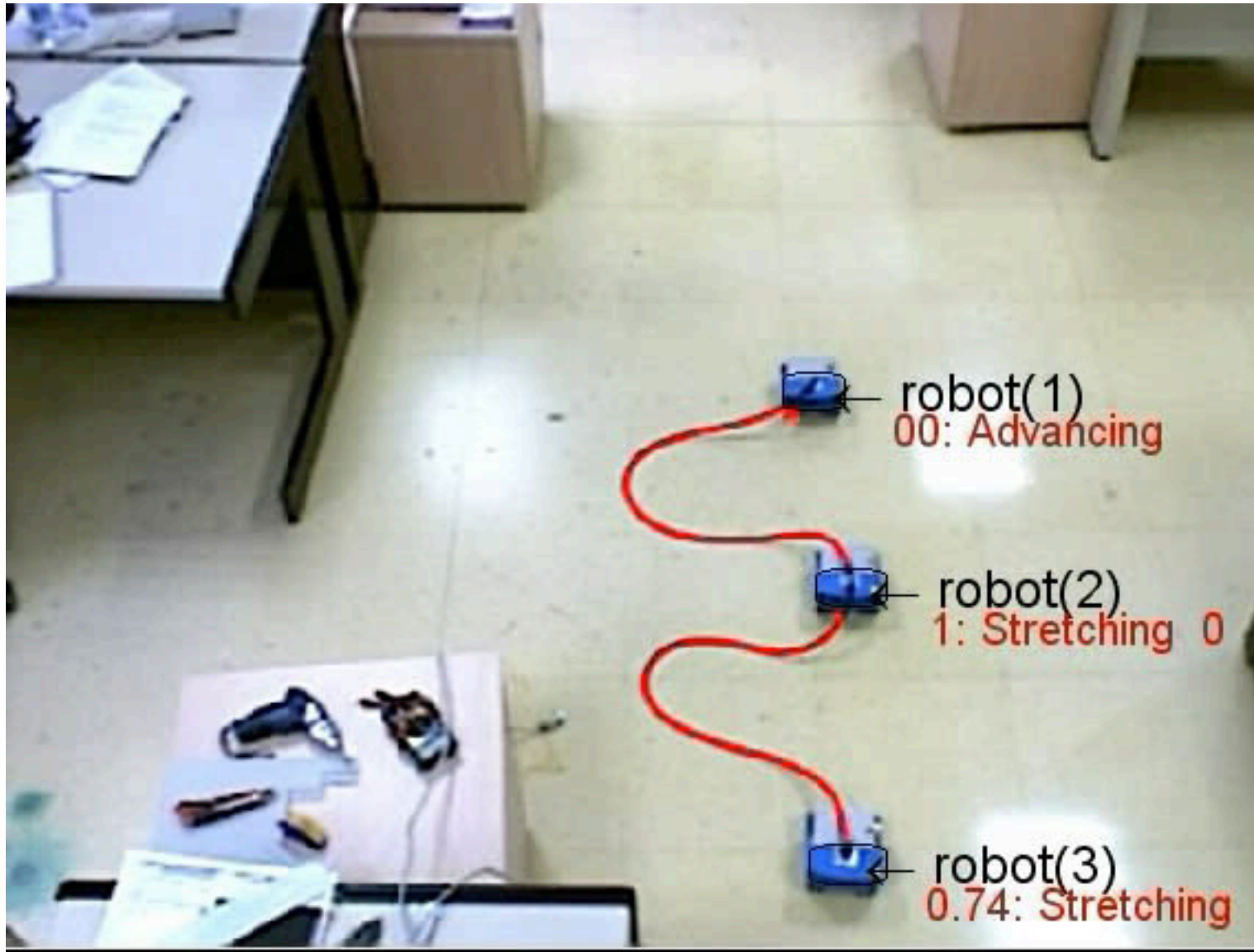
Remote sensing images

- Interested in hyperspectral images
- Unsupervised approaches
  - Clustering
  - Spectral unmixing
    - Endmember induction from the data
      - Lattice computing
- About to get a laboratory hyperspectral camera
  - Systematic, controlled experimentation with "real-life"data

Medical image processing

- Magnetic Resonance Imaging (MRI)

- Neuroscience applications

  - Recent growing collaboration with medical teams

- Actual issues

  - Image classification for diagnostic support

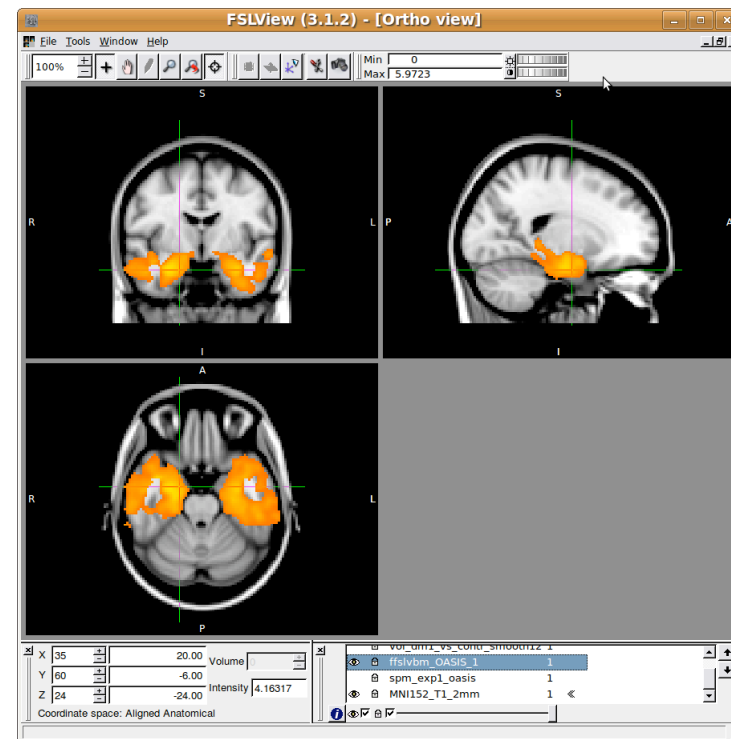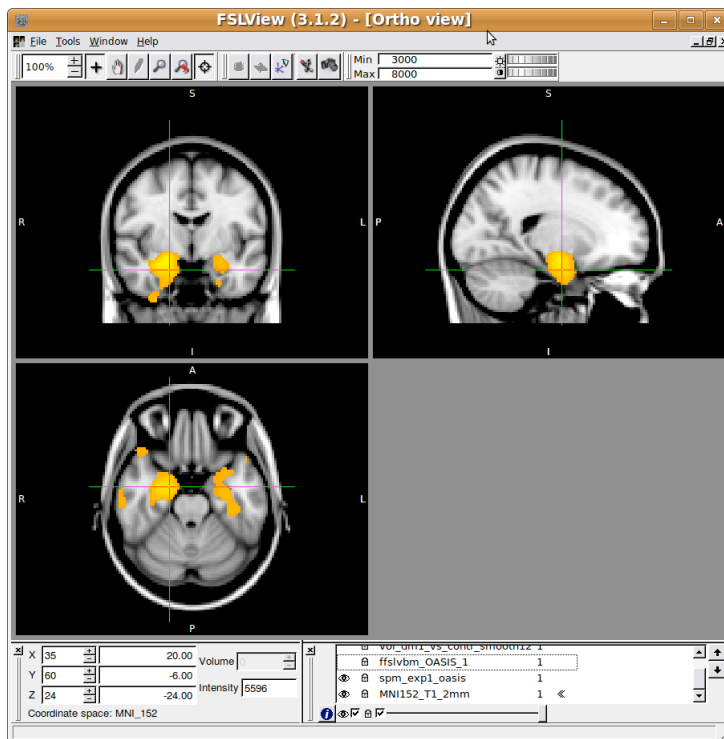 - Computational neuroanatomy: Voxel Based Morphometry

Medical image processing

- Lines of future interest
  - Multimodal image processing (DTI, fMRI,…)
  - Applications of Lattice Computing
  - Non linear registration processes
- Other imaging modalities and problems
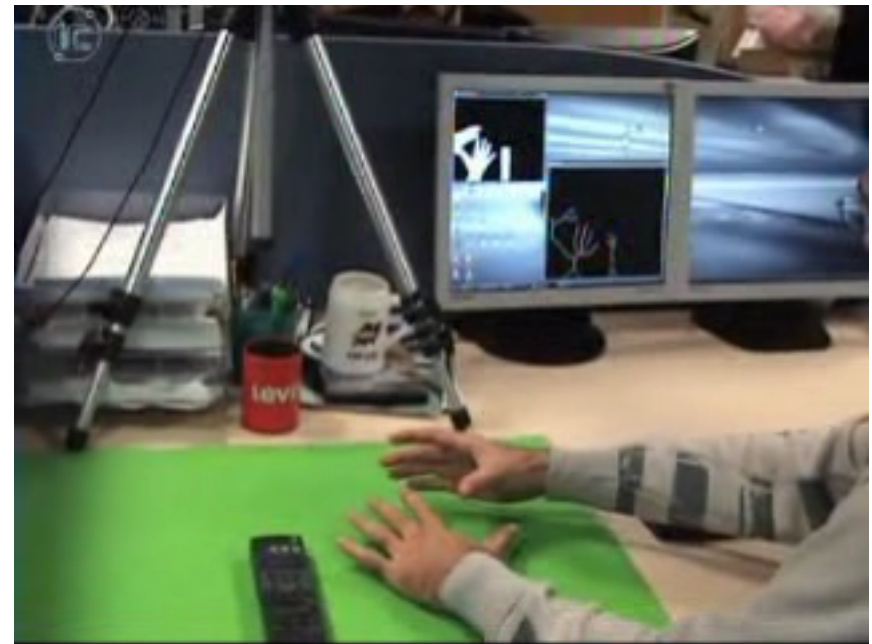 - Aortic aneurysms (external collaborator)

- Detection comparative results….

Human Computer interaction

- Voice recognition

- User modelling

  – Cognitive handicapped persons tutor

- Multimodal interacion

  – Hand gesture for tabletops

Summary of academic results

- Last three years
- Publications:
  - ISI JCR journals: 20
  - Other: 40
- PhD Thesis: 8
- Patents: 1?
- Project (Spain):
  - 5 (leaders) 4 (participation)