Intelligent Signal and Image Processing

Dr Amir Hussain
Professor Leslie Smith

Department of Computing Science & Maths
http://www.cs.stir.ac.uk/
Overview

• Computing Science at Stirling currently holds over £2m in external research grants
• There are 3 Main Research Groups in the Computing Science Department:
  – Computational Intelligence (CI)
  – (Tele)Communications & Services (C&S)
  – Care Technologies (CT)

• The primary signal and image processing areas are within the CI group:
  – Speech Processing (including multi-modal audio-video signal processing)
  – Neural signal processing (Neuroinformatics)

• There is also signal processing related work in care technologies and telecommunications services, as well as development of a USB board for signal input to Linux systems
Computational Intelligence (CI) - Overview

Senior Staff

• Professor Leslie Smith (Head)
• Dr. Amir Hussain, Reader
• Dr. Bruce Graham, Reader

• CI covers neural and natural signal processing, as well as modern optimization techniques such as genetic algorithms, particle swarm optimization and self-organizing multi-agent systems. It includes neurally inspired signal processing as well as processing techniques for neural signals.
CI - Application Areas

• Sound processing
  – Enhancing speech in noisy environments using intelligent multi-modal signal processing
  – Biologically inspired techniques for sound interpretation

• Neuroinformatics
  – Signal processing for neurophysiological signals

• Intelligent Control systems
  – Next generation controllers for complex systems using CI and machine learning techniques

• Optimization Problems
  – Treatment schedules and time intervention

• Diagnostic systems
  – Differential diagnosis of dementia syndromes

• Community support systems
  – CI to support field work in archaeology (and other areas)
<table>
<thead>
<tr>
<th>CI – Example Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>– CARMEN (Code analysis, repository, and modeling for e-Neuroscience) – large £4.5m EPSRC e-Science project involving 11 Universities (<a href="http://www.carmen.org.uk">www.carmen.org.uk</a>)</td>
</tr>
<tr>
<td>– Dynamical Information Processing in a Neuronal Microcircuit – understanding real neural systems – funded by the EPSRC</td>
</tr>
<tr>
<td>– COST 2102 on advanced speech and natural language processing, including multi-modal (audio and video) signal processing – funded by the European Science Foundation</td>
</tr>
<tr>
<td>– Symptom Modeling using Data Mining Techniques - funded by Cancer Research UK &amp; NHS Forth Valley</td>
</tr>
<tr>
<td>– Semantic Web Mining - this is a new EPSRC and industry funded project in collaboration with the world-leading MIT Media Lab (USA)</td>
</tr>
<tr>
<td>– Artificial Immune Systems: New Models and Applications – funded by BBSRC Network</td>
</tr>
</tbody>
</table>
CI - funding, collaborations and papers

- The CI group is funded primarily by research councils and the EU.
- The CI group works in conjunction with other larger Scottish University Departments
  - School of Engineering and Electronics at Edinburgh University
  - Signal & Image Processing and Industrial Control Centres at Strathclyde
  - Electronics and Electrical Engineering at Glasgow University
- Papers are published in a wide range of journals including:
- A new Journal of Cognitive Computation (published by Springer, USA) has been launched by CI members, which focuses on cognitive signal and image processing research – www.springer.com/12559
Commercial Exploitation & Technology Transfer - I

- The CS&M Department actively promotes commercial exploitation and technology transfer using Stirling University Research & Enterprise (SURE) Office to establish new industrial liaisons.
- The MATCH project is collaborative with eleven external partners and knowledge transfer is a key element.
  - MATCH applied processing to tele-care technology a rapidly growing market. MATCH works with Scottish Enterprise, SURE, BT, and ITI Techmedia.
- The Department has two Knowledge Transfer Partnership (KTP) projects, one with Think Analytics Ltd. and another with SysNet Ltd, both based in Glasgow.
- A new EPSRC CASE industrial PhD project in the area of statistical signal processing for semantic web mining is co-funded by Sitekit Solutions Ltd. and is being carried out in collaboration with MIT Media Lab (USA)
- Two members of the CI group are directors of a spin-out company (ITL) that is wholly owned by the University.
Research Themes: (Tele)communications & Services (C&S)

- The **Communications and Services** research group has a wide ranging interest in telecommunications service engineering across an array of network technologies, including voice, home and data networks.
- This applies the results of signal processing: for example
  - PROSEN (Networking of Distributed Sensors for Proactive Condition Monitoring of Wind Turbines) – funded by EPSRC and is a collaborative project between a number of universities and companies, including Stirling, Strathclyde, Essex and Kent. The focus is on the use of (wireless) sensor networks to provide **proactive** condition monitoring of wind farms.
Summary

- Computational Intelligence (CI) & (tele)Communications and Services (C&S) are our two main strengths: CI is more directly involved with signal and image processing.
- Within CI, sound processing and neural signal processing are our primary signal processing strengths.
- In addition we apply CI based techniques (for example bio-inspired techniques) to other fields specifically including signal and image processing aspects of their problems.
- We are keen to continue developing external collaborations, both with Universities and companies.
- We actively promote commercial exploitation and technology transfer and we work closely with the Stirling University Research & Enterprise (SURE) Office to establish new and effective industrial liaisons and partnerships.