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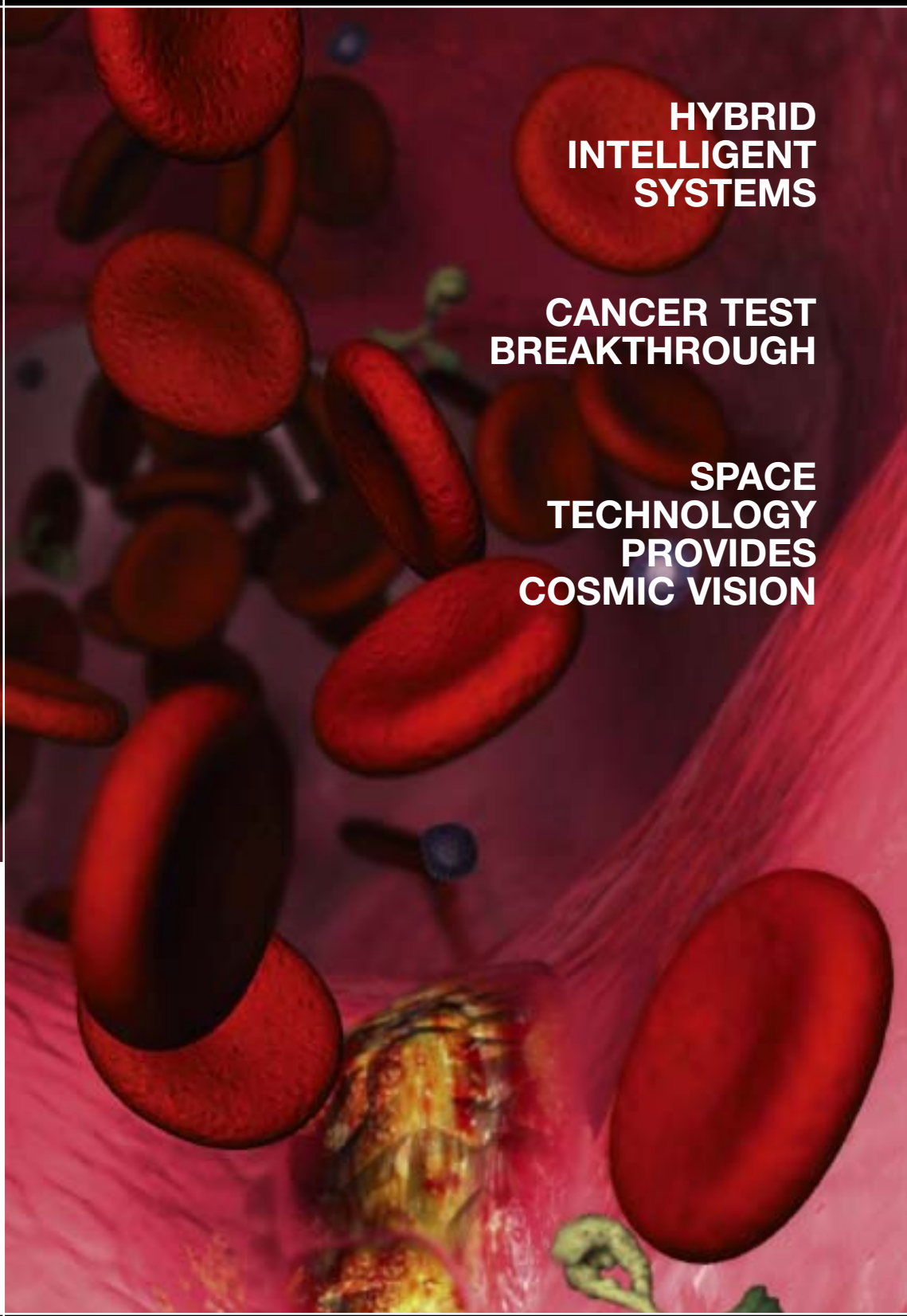
MEDICAL DEVICES AND INSTRUMENTATION



HYBRID INTELLIGENT SYSTEMS

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HYBRID INTELLIGENT SYSTEMS

Professor Wermter, Chair in Hybrid Intelligent Systems at the University of Sunderland, explains the necessity of integrating many different fields of science to produce more intelligent systems.

For many future computing applications such as adaptive software products for business industry, smart more autonomous automotive vehicles, ambient home environments, social robots, and interactive data mining for interdisciplinary business applications, we will need Hybrid Integrated Systems where systems benefit from the hybrid integration of various components: Software Engineering, Wireless Sensors Networks, Human Computer Interaction, Engineering, and Intelligent Learning Systems for automatic adaptation. In the future a greater need is expected for more selfadapting, selforganising, selfevaluating “organic” and “hybrid” computing systems based on novel forms of adaptive computation and integration for larger embedded integrated information and engineering systems.

The Centre for Hybrid Intelligent Systems in the School of Computing at the University of Sunderland has an international reputation for their research and development in these systems. The Centre’s objective is to research the foundations, representations and applications of hybrid systems in order to support various themes in information systems, engineering and interactive systems, in order to solve complex real world problems.

Encompassing the fields of Cognitive Science, Engineering, Life Sciences, Business, Human Computer Interaction, and Robotics, the foundation and motivation for our research often comes from natural systems, e.g. biological systems, neural systems or cognitive performance. We want to exploit these foundations in order to build more sophisticated adaptive interactive systems, learning agents, self organising information systems and robotic engineering systems. For building such nature-inspired computing systems we embed neural, statistical and/or symbolic representations into knowledge-based adaptive information agents. Applications include intelligent information systems, interactive systems, adaptive engineering, data/text mining systems, cognitive and neuroscience-inspired robots, speech/language systems, intelligent web agents and hybrid techniques for medical diagnosis.

We are coordinating and participating in several EPSRC and European research projects on neural networks, hybrid architectures, condition monitoring, neural robotics, vision and natural language engineering. In 2003/2004 Intelligent Systems won the British Computer Science Society’s Machine Intelligence Award for their work on neural networks. The team has coordinated the very successful EU MirrorBot project and are currently coordinating the EU project NESTCOM.

In the NESTCOM project, coordinated by the Centre for Hybrid Intelligent Systems, in collaboration with MRC Cambridge and University Parma, focus on the central question “what it means to communicate”. As our main focus we explore the characteristics of human communication and their relationships to the role of networks of mirror neurons. These neurons spike when a primate performs an action leading to a reward and when it observes another primate taking that action. They have been found in monkeys in Area F5. Area F5 is important in humans, because it is Broca’s area, playing a role in speech, and suggesting that mirror neurons are central for action understanding, imitation and communication development. The development of speech in human infants seems to involve an ‘understanding’ of the reward system of the other mind, and probably involves these neurons. The Hybrid Systems group builds computational models of these processes and tests them in robotic models.

The MiCRAM project, funded by EPSRC, is another collaborative interdisciplinary project performed between the University of Newcastle, School of Neurology, Neurobiology and Psychiatry and the University of Sunderland, Centre for Hybrid Intelligent Systems, School of Computing and Technology. The overall aim is to study sound processing in the mammalian brain and to build a biomimetic robot to validate and test the neuroscience models for focused hearing. We collaboratively develop a biologically plausible computational model of auditory processing at the level of the inferior colliculus (IC). This approach will potentially clarify the roles of the multiple spectral and temporal representations that are present at the level of the IC and investigate how representations of sounds interact with auditory processing at that level to focus attention and select sound sources for robot models of focused hearing.

Intelligent Systems knowledge transfer projects in the North East and UK have brought benefit to both large companies and SMEs, including intelligent software to predict distortion in the manufacturing processes for printed circuit boards (XAct PCB Ltd); an intelligent pattern matching algorithm for increased security for credit and cash cards now being further developed with a major bank (PinOptic Ltd); and an intelligent pattern matching algorithm for the selection of personal vehicle registration numbers (National Numbers Ltd). The OVER Project aided West Midlands Police with a sophisticated forensic computing system for crime data analysis. The HAPPI project applied Natural Language Engineering (including psycholinguistic databases) to simplify language in timely material (online news) to make it accessible to individuals with alexia as a result of stroke. Furthermore, Hybrid Intelligent Systems contribute extensively to knowledge transfer via project collaborations with BT, Reuters (natural language processing/classification), ActiveMedia and BAEsystems (cognitive robotics), Sage (data mining), and Nonlinear Dynamics in the North East (statistics knowledge transferred to biotechnology).

In the Centre for Hybrid Intelligent Systems we always aim at linking our research to teaching and reachout in order to enhance the student’s experience. Today’s knowledge-based society provides students with exciting future-oriented job opportunities in education, research and industry. Typical are the interdisciplinary advantages which can be gained by integrating knowledge from Computing, Cognitive Science, Engineering, Life Sciences, Business, Human Computer Interaction, and Robotics. Therefore for October 2008 we have designed a new MSc programme, MSc Integrated Information Engineering. The programme is a new synthesis of interdisciplinary areas with a clear application focus. The programme emphasises the integration of established computing and engineering concepts with novel forms of neural learning, artificial intelligence and human-computer interaction. Topics include understanding users, internet interaction design, e-technologies for management, interactive robots, intelligent systems, and ambient systems. In additional research, professional and legal issues are an integral part of the curriculum. We welcome enquiries from interested MSc students.

For further information contact Professor Dr Stefan Wermter or visit **www.his.sunderland.ac.uk**