ICHEC NEWS

UPDATES FROM THE IRISH CENTRE FOR HIGH-END COMPUTING

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Creating a world-class infrastructure

Ireland partners with 19 other European countries to set up supercomputing research infrastructure.

Ireland has been a member of the Partnership for Advanced Computing in Europe (PRACE) since 2008 and from July 2010 ICHEC will become a full (non-hosting) partner.
By devising and implementing an all-encompassing strategy, from small-scale and trivially parallel computations all the way to genuine Grand Challenge computing, ICHEC has successfully met one of its key objectives: to bring a number of Irish computational research groups to a position where they are now competing with their international peers, with matching access to high-end systems among the top 20 fastest supercomputers in the world.

Read more about ICHEC's international activities in our special feature on pages 4 and 5.

ICHEC assists DECI applicants

ICHEC is pleased that it was able to assist five groups with the completion of applications for this year's DEISA Extreme Computing Initiative (DECI). We wish these researchers the best of luck. Should they be successful, they will be granted access to significant amounts of computing resources and expertise on a host of Europe's leading HPC systems.

Irish scientists showcase Grand Challenge problem on newest French supercomputer

We are also very pleased that Dr Niall English of University College Dublin, together with colleagues and Gilles Civario of ICHEC, has been successful in a recent application for a substantial amount of compute time on the CINES JADE system in Montpellier. Like ICHEC's Stokes system, JADE is an SGI Altix ICE; however, it is significantly larger, having 23,040 cores for 2,880 nodes, i.e., nine times more powerful than Stokes.

The CINES JADE system in Montpellier (machine owned by Grand Equipment de Calcul Intensif [GENCI], and operated by Centre Informatique National de l'Enseignement Superieur [CINES]). (Reproduced with permission.)

New team members at ICHEC

Welcome to issue 8 of *ICHEC News*, the newsletter dedicated to bringing researchers and institutions up to date with the latest high-performance computing news from Ireland. In this issue you'll find information on new recruits to the ICHEC team and we'll take a look at the close ties between ICHEC and the Edinburgh Parallel Computing Centre (EPCC). We will review the first year of Stokes' performance, as well as updating you on the e-INIS consortium. Our special feature focuses on important developments within PRACE, and we will also highlight the recent research success of one of our users. We hope you will find *ICHEC News* to be a valuable source of HPC news and information.

Professor Jim Slevin
Director

New appointments at ICHEC

Four new members of staff have joined the team at ICHEC.

New recruits to ICHEC (from left): Adam Ralph; Ruairi Nestor; Eoin Brazil; and, Shiyu Wang.

Adam Ralph joined our staff as part of a joint research collaboration with SGI in January 2010 and divides his time between ICHEC and NUI Maynooth. He focuses on environmental science research and is working to couple distinct climate models using OASIS4, in collaboration with the Climate Research Group in Maynooth. Adam's BSc was in theoretical physics with a DPhil in crystallographic phasing methods. After some years in Italy and the UK as a postdoctoral researcher, he gained industry experience as a senior programmer with a crystallographic software suite in the UK (CCP4), before moving into systems administration and assistance of the Electron Microscopy Group of the MRC Virology Unit in Glasgow. In Ireland Adam has been working with the Department of Mathematics in Maynooth, teaching undergraduate level mathematics.

Ruairi Nestor joined ICHEC in February 2010 as a computational scientist. At ICHEC, Ruairi draws on his experience in the field of computational mechanics to provide support to the HPC activities of the engineering research community. Ruairi obtained a BE in Mechanical Engineering from NUI Galway in 2005. In the third year of his BE, he worked in the Quality Control Department of ABAQUS Inc. (now Simulia), RI, USA. He then undertook a PhD, also at NUI Galway, under the supervision of Dr Nathan Quinlan. For his PhD, Ruairi worked on the development of the finite volume particle method (FVPM), a mesh-free method for computational fluid dynamics (CFD). As part of this work, several advances on the basic FVPM were developed, including the extension of the method to viscous flow, incompressible moving-boundary flows and fluid-structure interaction.

Eoin Brazil joined us in February 2010 as part of the technology transfer team. As a software developer and consultant he will be providing solutions and services to Irish companies. Eoin has worked for nine years in various projects and technical roles in the Interaction Design Centre in the University of Limerick (UL). He studied computer systems at UL where he gained a BSc (hons) in 2000. He received an MSc for work on using multiple visualisation techniques and dynamic queries for browsing audio resources, and a PhD in 2009 for work on the use and design of everyday sounds for computer interfaces. His previous research has been primarily in the fields of auditory display and sonification. He is a management delegate for Ireland on the European COST action on "Sonic Interaction Design", and a member of its working group on sonification. He is a board member of the International Conference on Auditory Display.

Shiyu Wang joined ICHEC in December 2009 as a researcher under the Environmental Protection Agency's STRIVE Programme. His research mainly focuses on the impacts of climate change on Irish weather extremes, particularly precipitation and its impacts in pluvial/fluvial flooding, drought, and wind. This project will address a key issue: the uncertainty in current predictions. The project will also be linked with the EC-EARTH project in Met Éireann and will use the simulation outputs from EC-EARTH to augment the available data. Previously, as an EPA research fellow with both University College Dublin and Met Éireann, Shiyu's research focused on developing a state-of-the-art regional atmosphere–ocean coupled model for Irish waters and climate modelling for the Community Climate Change Consortium for Ireland (C4I) project.

Further details, including biographies of all ICHEC staff, can be found at http://www.ichec.ie/about_us/contact.

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International collaboration

ICHEC's relationship with EPCC goes from strength to strength.

For the last six months, ICHEC has been delighted to welcome Nicola McDonnell, a Principal Consultant from the Edinburgh Parallel Computing Centre (EPCC), to the Dublin hub. A graduate of Trinity College Dublin, Nicola has very much enjoyed the experience: "It's been really interesting. Prior to the secondment, I had visited many other supercomputing centres but never had the opportunity to work in any of them: and it's been lovely to be at home".

During her time at ICHEC, Nicola has been working on a number of projects, both technically and managerially. In particular, she has been applying PRINCE2 project management methodology to two projects: the ICHEC User Management System; and, the Bio Portal, a portal for Irish bioinformatics applications for Irish and international users. In addition to her project management role, Nicola has also been involved in a technical project using GPGPU units to accelerate weather forecasting code. She is working with Prof. John Sweeney and Dr Rodney Teck of NUI Maynooth on the physics kernel of the Weather Research & Forecasting model (WRF).

The relationship between ICHEC and EPCC goes all the way back to ICHEC's establishment in 2005, as Associate Director Dr J-C Desplat explains: "I worked at EPCC for 10 years before coming to Ireland to help set up ICHEC. EPCC is often regarded as one of the premier HPC centres in Europe, operating a truly world-class national HPC service in the UK. So it should be no surprise that although we did not model ICHEC directly on EPCC, we imported many best practices and novel ideas, which in turn proved invaluable in establishing the Irish national HPC services to world-class standards within a very short timescale."

The first exchange of staff took place in 2007, when Systems Administrator Eoin McHugh travelled to Edinburgh at EPCC's request to assist in the setting up of HECToR, the UK's high-end computing resource. The mutually beneficial nature of both of these exchanges means that both centres are keen for them to continue in the future.

One of the main aspects of EPCC's work that ICHEC has sought to emulate is in the area of technology transfer. "EPCC has a very successful technology transfer programme that has been running for 20 years. ICHEC aims to do something similar, to offer pragmatic problem-solving assistance to businesses, especially small and medium enterprises (SMEs). We are receiving guidance from EPCC in setting up our technology transfer programme: in the current climate, organisations like ICHEC have a responsibility to assist in job creation and the development of the smart economy," says Dr Desplat.

EPCC Principal Consultant Nicola McDonnell is on secondment at ICHEC.

For the future, ICHEC and EPCC expect to collaborate more directly through their joint participation in EC-funded projects, the first of which is the PRACE project featured in this issue (see page 4). But whatever the outcome of future funding applications, a strong working relationship between ICHEC and EPCC will no doubt continue.

Watch this space…

Over the coming months, *ICHEC News* will feature updates on a number of projects.

Met Éireann

ICHEC and Met Éireann are involved in a collaboration to develop and run both climate and numerical weather forecast models. Currently, this involves the HIRLAM and HARMONIE weather models, as well as the EC-Earth climate model. Met Éireann is moving to increased resolution forecasting models. The large operational HIRLAM model (covering the North Atlantic, the source of much of Ireland's weather) is moving from a 15km grid to a 10km grid, while the fine-scale HIRLAM model of Ireland is being replaced by a 5km HARMONIE model.

The HARMONIE model is a non-hydrostatic model developed by combining two existing weather models: HIRLAM, developed predominately for Northern European weather services (including Met Éireann), and ALADIN, led by Météo-France and partners. This state-of-the art model promises more precise, localised forecasts of precipitation and extreme weather. To implement this, Met Éireann will be using 128 cores of the Stokes supercomputer at ICHEC (up from 64 cores for HIRLAM). The HARMONIE model has been implemented and optimised at ICHEC over the last two years under a collaboration between Met Éireann and ICHEC. Keep an eye out for further details on the ICHEC–Met Éireann collaboration in future issues of *ICHEC News*.

ICHEC and novel architectures

ICHEC strongly believes in the future of GPGPU technology. General Purpose computing on Graphics Processing Units has become increasingly popular in the HPC community in recent years, in addition to its more traditional role in visualisation work.

While GPGPU is not the only path towards widespread availability of Pscaling computing, it is arguably the most promising one. ICHEC has therefore invested effort in this area and with considerable success, and in the next issue of *ICHEC News*, we will feature our GPGPU developments in more detail.

Inaugural meeting of PRACE, June 9, 2010 (Dr J-C Desplat of ICHEC, second from left).

World-class research infrastructure for world-class science

J-C Desplat describes ICHEC's expanding role in European and other international access programmes that are contributing to major successes for Irish researchers.

When ICHEC was established in 2005, one of its main ambitions was to "bring capability computing to Ireland", allowing Irish computational research groups to compete on a level playing field for frontiers research with their peers in larger countries. However, it quickly emerged that securing the levels of capital investment required to deploy the type of high-performance computing (HPC) infrastructure found in the US, or even in France, Germany or the UK, was simply unrealistic (c. €100m over five years). In addition to this, the skills gap required to bring user codes using dozens of CPU cores to tens and even hundreds of thousands of cores was equally challenging.

PRACE

To address these and other issues, the Partnership for Advanced Computing in Europe (PRACE – www.prace-project.eu) was established as a pan-European research infrastructure providing outstanding computing services to enable world-class research on world-class systems. Five European states (Germany, France, Italy, the Netherlands, and Spain) committed to fund and host leading edge computer systems at the highest performance level in Europe (known as Tier-0). Twenty member states collaborated in the first implementation phase to accelerate the deployment of the PRACE service to users from academia and industry. Ireland joined PRACE in May 2008 by signing the PRACE MoU, and we are glad to announce that ICHEC will become a full (non-hosting) partner in July 2010, when the EC FP7-funded first implementation phase begins. Besides national representation, looking after the interests of Irish research groups, ICHEC will also endeavour to represent the interests of smaller countries. On the technical side, ICHEC's involvement will focus on 'Pscaling' applications, GPGPU computing and training. The PRACE AISBL legal entity was established in April 2010, with Ireland

Irish presence in PRACE

Irish interests in PRACE are represented through ICHEC's participation in the PRACE Council, the highest executive organ of the research infrastructure. But this is not the full extent of the Irish presence, as it can also be felt strongly in the Scientific Steering Committee, with the nominations of Prof. Chris Bean and Prof. Giovanni Ciccotti to this body, and the presence of Prof. Luke Drury as observer. Other Irish scientists, such as Dr Patrick McGarry, are also involved as international reviewers. Finally, let's not forget the five Irish principal investigators who have already availed of these facilities as part of the prototype access initiative!

Prof. Jim Slevin (right), Director of ICHEC, signing the PRACE MoU in 2008.

Representatives of PRACE member states at the recent inaugural event, including Dr J-C Desplat, Associate Director, ICHEC.

Juelicher BlueGene/P (Jugene) Pflop computer at the Julich Research Centre, Germany. (Reproduced with permission.)

(through ICHEC) as a founding member. Its temporary seat is in Brussels. Five Irish research groups have already benefitted from access to the PRACE Prototype scheme in Q4-09/Q1-10, through which they have collectively been awarded 8.7m core-hours on some of the most powerful supercomputers in Europe. In fact, with five projects accepted (out of nine accepted Europe-wide) for the first two prototype calls, Irish researchers have achieved the greatest visibility in Europe. Among those projects, one should single out those of Dr Turlough Downes (DCU/DIAS) and Professor Gary McGuire (UCD) for their technical achievements, both demonstrating excellent scalability of their applications to 250,000+ cores. Irish users are now ready to apply for more substantial resources through the PRACE production service, which is due to open in Q3-10. Two calls will be issued in this year.

DECI

Another initiative where further Irish successes have been recorded is DEISA, the Distributed European Infrastructure for Supercomputing Applications (www.deisa.eu). The main distinction from PRACE is one of scale, with DEISA providing resources for codes utilising hundreds to thousands of cores (known as Tier-1). We are glad to report that three Irish projects (out of seven) had their applications accepted at the last and final call of the DEISA Extreme Computing Initiative, DECI. This is an impressive achievement, considering the very competitive nature of this programme, with resources ten times oversubscribed for this specific call!

Further afield

Beyond large-scale European access programmes such as PRACE and DEISA, ICHEC has started investigating access to major sites in the US, as well as access to EU National Services such as the EPSRC/EPCC HECToR (UK) and GENCI/CINES Jade (France) services. ICHEC's strong relationship with the latter facilitated access for Dr Niall English (UCD) to demonstrate the suitability of Jade to address Grand Challenge problems on CINES' 23,040-core cluster. We will report on this success story in more detail in the next issue of *ICHEC News*.

By devising and implementing an all-encompassing strategy, from small-scale and trivially parallel computations all the way to genuine Grand Challenge computing, ICHEC has successfully met one of its key objectives: to bring a number of Irish computational research groups to a position where they are now effectively competing with their international peers with matching access to high-end systems among the top 20 fastest supercomputers in the world. This success has only been made possible through the close and effective collaboration between those groups and the team of ICHEC computational scientists. Long may it continue!

Looking forward, the future of high-end computing in Ireland has never been brighter. ICHEC continues to drive forward with an ambitious agenda, preparing for the future by harnessing the technical challenges of the newly emerging CPU/GPU hybrid architectures. ICHEC is now established as one of the leading centres in Europe in that field. We intend to engage with the local research community to allow them to be among the best equipped in Europe to exploit this truly disruptive technology … but that is a story for the next issue of *ICHEC News*.

Dr J-C Desplat
Associate Director of ICHEC

Emergent behaviour in complex adaptive systems of autonomous agents: model for collective search in animal groups

Colin Torney* and Zoltan Neufeld, School of Mathematical Sciences and Complex Adaptive Systems Laboratory, UCD.

FIGURE 1: Examples of collective movement of animal groups.

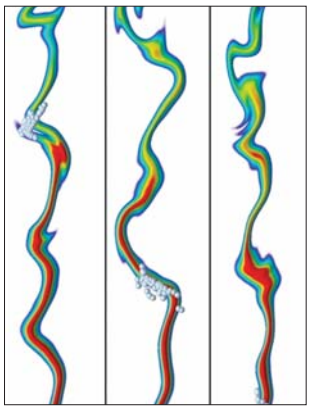

FIGURE 2: Snapshots of computer simulation of collective search behaviour of 60 particles tracking a meandering filament of chemical signal in a turbulent flow.

Introduction

Throughout the natural world organisms are constantly faced with the challenge of locating the resources required for their survival. Often this means navigating their environment based on spatiotemporally varying information such as advected chemical cues, thermal gradients, magnetic fields or gradients of food-item density, and trading off exploitation of acquired information with exploration to collect new information. Responding to information effectively in these environments is a difficult task since the spatial correlation lengthscale of stochastic effects, such as eddies or local magnetic-field/resource fluctuations, can often be significantly greater than the perception range of the organism, while chaotically advected signals are stretched and folded into heterogeneous concentration structures, where information becomes highly localised on thin filaments. These effects mean that individual strategies based solely on local conditions are often unsuccessful. Through social interactions, however, organisms may be able to more effectively process information since they may be able to sample over larger areas, make consensus decisions and even exhibit collective memory about their previous states.[1,2] Such co-ordinated search is a hallmark of current strategies for artificial collective search, from groups of robots to interacting software components seeking to search large and complex data sets.

Recent work in the area of complex adaptive systems has shown how functional, collective behaviour can result from the interactions between autonomous individuals in the absence of centralised control. Led by the studies of biological systems such as ant colonies and fish schools, this work is now being used as inspiration for the design of distributed robotic or artificially intelligent systems. With the recent, rapid growth in feasible and inexpensive sensing, communicating and computing technologies, large-scale distributed systems and networks hold enormous potential to monitor, explore and even interact with their environment to a degree never before imagined.

Individual based models

The emergent collective behaviour of such systems can be efficiently studied by computer simulations of individual based models. In such so-called agent-based models, the behaviour of the system is represented by a set of particles interacting with each other and their environment similar to particles in a physical system (molecules, electrons, etc.), but allowing for a much broader repertoire of interactions than the ones arising from usual physical forces, representing the complex internal structure of "agents" with multiple sensors and ability to make complex decisions. This computational modelling approach has been used in many areas including the simulation of animal groups such as bird flocks, fish schools, swarms of insects, microorganisms or human crowds.[3,4]

Context-dependent interaction

Key ingredients of animal group interactions include components such as: 1. short-range repulsion (to avoid collisions); 2. long range-attraction (to maintain cohesion); and, 3. alignment of the orientation at intermediate distances to co-ordinate collective motion of the group (**Figure 1**). For such group interactions to be used in tracking complex dynamically changing signals (like odour plumes in a turbulent environment) the individuals need to be able to sense the local concentration of the chemical signal and have a short-term memory to compare current and recent intensities. This allows each individual to assess its own direction of motion, and can be coupled to group behaviour by context-dependent interactions as we have shown in a recent article.[1] The basic principle of the context-dependent interaction is that individuals experiencing a strengthening chemical signal tend

to ignore the rest of the group by reducing their interaction distances, while they respond to a weakening signal by strengthening social interactions over increasing distances. The resulting collective search behaviour is illustrated in **Figure 2** showing snapshots of a simulation of 60 particles tracking a meandering chemical signal in a chaotic flow in order to locate the source of the signal.

By taking advantage of high-performance computing facilities, these realistic environments can be simulated and the effectiveness of collective search strategies quantitatively assessed. The flow field in our simulations is generated by a synthetic turbulence model, while a semi-Langragian scheme, distributed across multiple processors, is used to advect the chemical signal. Groups of interacting agents are run on individual processors so that numerous instances may be run in parallel, allowing for large-scale, efficient scanning of parameter space and the key components of the system to be identified and their roles understood.

Our model illustrates how context-dependent interaction rules lead to a dynamically changing leadership structure within the group, producing an emergent cognitive capacity that does not exist at the level of individuals. These underlying principles can work well in animal groups such as fish, birds or even microorganisms communicating through chemical signals and can also be applied to robotic search strategies. Such distributed systems are of particular interest in robotics due to advantages over the traditional paradigm of centralised control, notably the absence of communication time, inherent robustness (any given component is expendable), and cost effectiveness, as large numbers of simple components can be manufactured efficiently. Such collective strategies also raise interesting questions on evolutionary aspects of the problem, i.e., what kind of evolutionary or learning mechanisms can lead to optimal adaptive tuning of the collective behaviour, how to avoid cheaters who benefit from but don't contribute to the group level information, or under what condition evolutionary dynamics leads to specialisation of individuals and evolutionary branching.

This project was funded by SFI RFP and STTF grants. Computational facilities and support were provided by the Irish Centre for High-End Computing.

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Summer Scholarships 2010 – underway

The ICHEC Summer Scholarships are awarded to a select few undergraduate students to carry out 10-week summer projects at our offices in Dublin and Galway. The scholarship provides a generous stipend and accommodation subsidy for the relevant student. Applicants are able to choose from a variety of project topics, which include getting involved in a multitude of scientific codes (in climate, molecular dynamics, bioinformatics, or engineering), and exciting opportunities in GPGPU and other HPC subjects. Each project is supervised by one of our computational scientists, and in some cases by a secondary supervisor from a third-level institution.

In our next issue, we will feature an update on the work that our scholarship students are carrying out this summer.

Quantum ESPRESSO workshop

From June 14-18, ICHEC and the Tyndall National Institute hosted a workshop on the theory and practical use of Quantum ESPRESSO (www.quantum-espresso.org), an integrated suite of computer codes for electronic structure calculations and materials modelling at the nanoscale level. Topics covered at the workshop came from a range of contemporary Quantum ESPRESSO applications: from simple electronic structure calculations, to the most sophisticated theoretical spectroscopies. The workshop was intended for postgraduates and researchers who are familiar with the field and who want to use state-of-the-art electronic structure theory codes and take full advantage of massive parallelisation using multiprocessing and multithreading techniques. A team of international experts, including some of the developers of Quantum ESPRESSO from the DEMOCRITOS National Simulation Center, presented the lectures. ICHEC staff assisted with the tutorials. ICHEC also provided additional access to the course by streaming video from the event to the HPC hub in Dublin. There were 24 attendees in Cork and three in Dublin; nine of the total 27 attendees came from international institutions to attend the workshop.

Courses on demand

We deliver HPC courses on demand and free of charge to any third-level institution in the country. In order for us to deliver a course at your institution, all you need is the following:

- **at least eight people who would like to attend the course;**
- **a person to co-ordinate matters at the host institution; and,**
- **booking of a suitable venue with laptops/computers for each attendee.**

If fewer than eight people are interested, we also have the facilities to hold courses for small groups at our HPC hub in Dublin (http://www.ichec.ie/infrastructure/hpc_hub). So if you know a few people in your research group or department who would be interested, please visit our website – http://www.ichec.ie/education_training/training_courses – or contact us at training@ichec.ie for further details.

Dr Simon Wong
Computational Scientist and Training Co-ordinator

National data store

The e-INIS project's pilot national data store is an important step toward ensuring capability and competitiveness in the emerging fields known as data-intensive research. Two research groups are already benefiting from the southern regional data store operated by the Boole Centre for Research Informatics at University College Cork.

The Neonatal Brain Research Group (NBRG) is investigating brain injury and seizures in newborn babies. Apart from serving as a repository for the Tbytes of clinical data that the group has amassed to date, the e-INIS storage is actively supporting two research projects: NEMO and BabyLink. NEMO (Treatment of NEonatal Seizures with Medication Off-patent) is a pan-European research project into the efficacy and safety of bumetanide, a drug that could potentially be used to treat seizures in neonates. The NEMO collaborators are using the e-INIS storage as a repository for EEG data gathered during the course of the trial. BabyLink is a related project that aims to provide a remote teleneurophysiology service to neonatal intensive care units. This is achieved by streaming live EEG data from the patient's location to neurophysiologists' PCs, regardless of the location of both. The system is currently being deployed to the Cork University Maternity Hospital. The e-INIS southern data store will be used to manage the large volume of data expected to be acquired by the system.

Other early adopters in UCC are The Centre for Research into Atmospheric Chemistry (CRAC). The CRAC has acquired an aerosol time-of-flight mass spectrometer (ATOFMS, TSI Inc.), which allows the simultaneous measurement of the size and chemical composition of individual atmospheric particles in real time. This information is particularly useful for identifying and apportioning the various local and regional sources of these particles, in order to assess their impact on air quality. Typical sources include vehicular traffic, domestic combustion and power generation. Up to two million mass spectra can be collected over a three-week period; therefore, the machine generates several Gbytes of data per day while operating in the field. The ATOFMS has been used successfully in field campaigns at Mace Head in Co. Galway, Tivoli Docks in Cork City and most recently in Paris as part of the pan-European MEGAPOLI Megacities campaign.

The e-INIS storage has proven invaluable as a repository for the data gathered in field campaigns, allowing data to be shared easily for analysis by all members of the CRAC. Furthermore, there are plans to use the data store as a platform for collaboration with partner institutions, in particular the Centre for Climate and Air Pollution Studies (CCAPS) at NUI Galway, by facilitating the sharing of complementary data and analysis results.

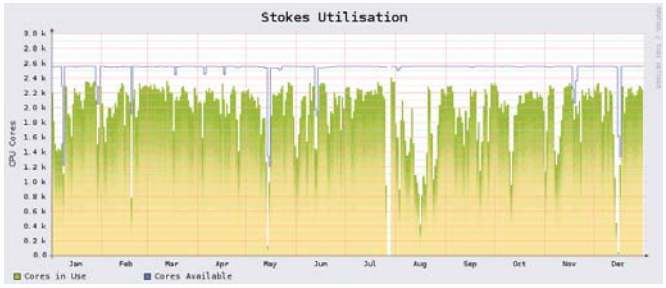
The e-INIS federated data facilities are funded as a national research resource and as such are available on an equitable basis to all Irish research groups. Applications should be made on behalf of a community of users with a national dimension and should include a comprehensive strategy for data management and access control. Where possible, proposals should include an outreach and education component allowing the infrastructure to improve the accessibility and relevance of research data to the general public and also to undergraduate teaching and graduate school programmes.

Dr Keith Rochford
e-INIS Project Co-ordinator – outreach@e-inis.ie.

Thanks to Dr Philip Healey and Dr Robert Healey for their contributions to this update.

Stokes reaches optimum utilisation

In the first calendar year of service, Stokes has displayed excellent levels of reliability and utilisation. The system was offline for maintenance work for a total of 82 hours during 2009 and for 32 hours as a result of unscheduled downtimes.



This translates to an availability of 98.7% and a servicability of 99.7% for 2009. Utilisation of the system was also remarkably high throughout the year with just one marked decline in activity during the August summer holiday period. The graph shows the availability and utilisation of Stokes throughout the year. The average utilisation level for the system as a whole over 2009 was 78.3%. For a batch processing system with reserved development nodes, this figure is approaching the optimum, with international opinion in the HPC field tending towards a figure of approximately 85% occupancy as being the best compromise between fully using resources and providing a quality user experience with quick turnaround times.

Niall Wilson
Infrastructure Manager

sfi science foundation ireland fondúireacht eolaíochta éireann
HEA Higher Education Authority An tÚdarás um Ard-Oideachas
AN ROINN OIDEACHAIS AGUS EOLAÍOCHTA | DEPARTMENT OF EDUCATION AND SCIENCE
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