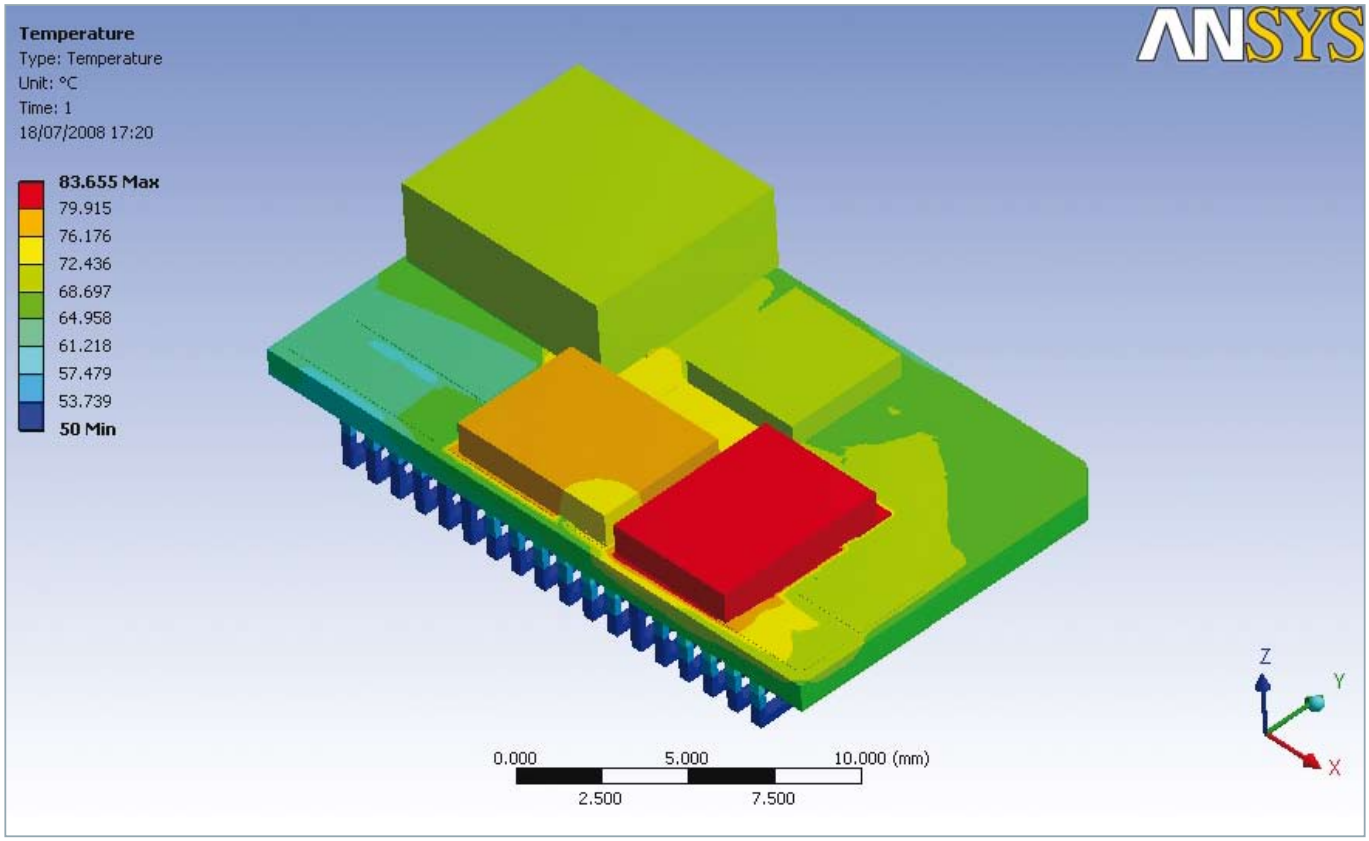


Figure 1: Temperature Contours in a PCB

INNOVATION IN SIMULATION

Companies involved in R&D are under competitive pressure to produce innovative, robust designs at lower cost and in less time. Computer simulation is being used increasingly as an integral part of the design process to meet these demands. Derek Sweeney, founder and managing director of IDAC Ireland Ltd, which has delivered automated simulation applications for medical device companies, including some of the world's largest multinationals, talks to the Journal about his company's track record of innovation in this niche.

IDAC can provide its services to any company involved in new product design (Figure 1 shows an electronics application.) Derek says, but it has specific expertise in the simulation of medical devices. Medical device customers include large multinationals, such as Abbott Vascular and Boston Scientific, and small start-ups such as Novate Ltd, Galway. Derek outlines the Novate project which IDAC are collaborating on: "Novate are developing an innovative vena cava filter for treatment of patients who are at risk of deep vein thrombosis. The device must conform closely to the vena cava wall, but still provide sufficient stiffness and fatigue strength.

"To help to achieve this design balance, Novate have used IDAC's services at each design iteration, to simulate deployment of the device inside the vessel and calculate fatigue life. Novate plans to commence a clinical trial in 2009."

Stent design applications

IDAC developed a suite of applications for stent designers as part of an EU funded project, BloodSim. Abbott Vascular, California, are one of the customers using these applications to develop coronary and peripheral stents. The applications are delivered to the stent designers over the company intranet. Derek describes how this works: "The designer uploads a stent geometry and within hours has a report which details the structural characteristics of the design (stiffness, change in length, fatigue life, strut balance, maximum stress and strain). The system ensures the designers get the information they need to make decisions in a timely manner. Future possible developments of this system include delivering over the internet on a pay per use basis. This delivery model would suit small manufacturers and give them access to high end simulation tools."

As a member of the TechNet Alliance, a worldwide network of engineering solution providers, IDAC is a strong proponent of the importance of networking with other technology experts.

@neurIST

The company is currently involved in another European Project called @neurIST. This is a major multidisciplinary European initiative within the Sixth Framework Programme.

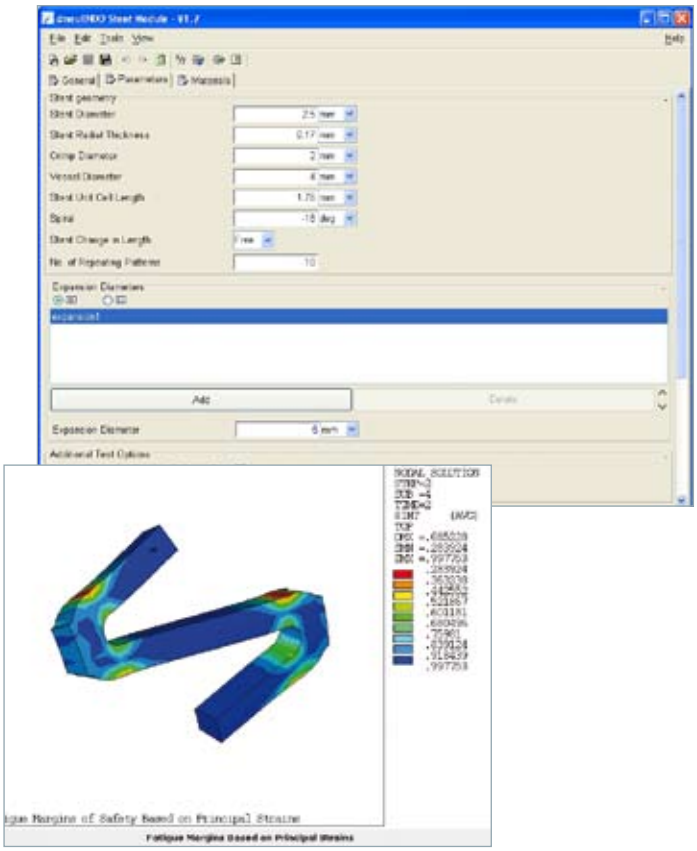
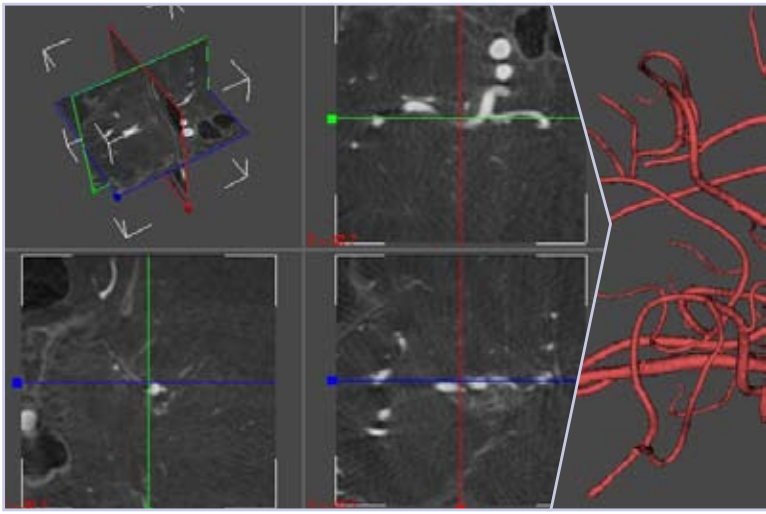


FIGURE 2:
Workflow for the Stent Designer

FIGURE 3: Workflow for the Clinical End-User

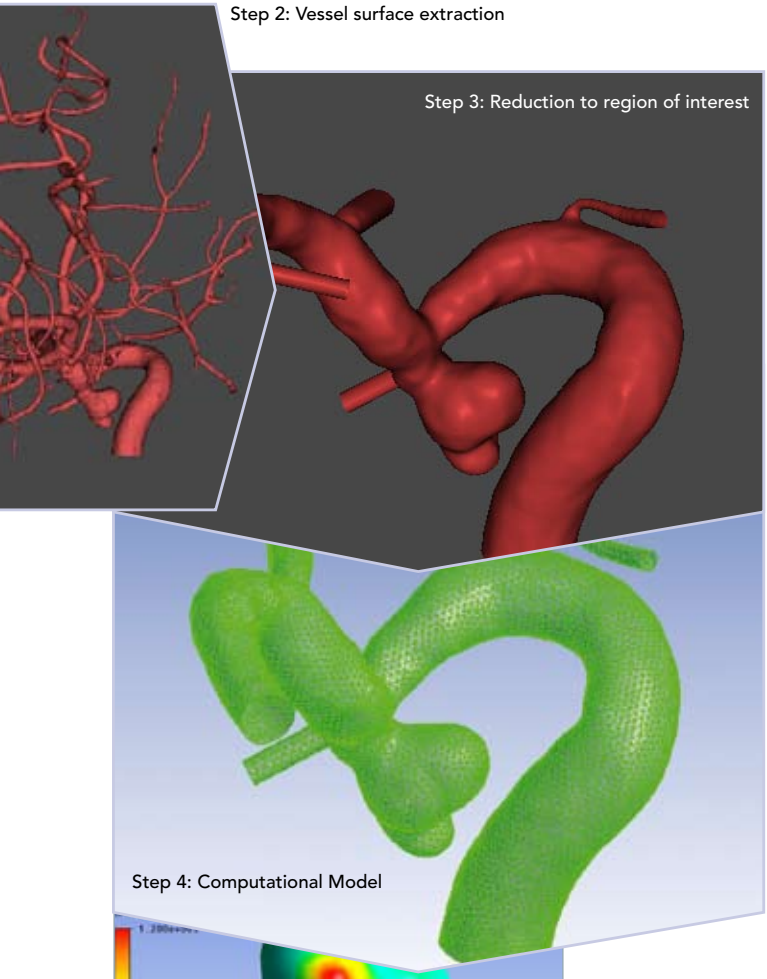


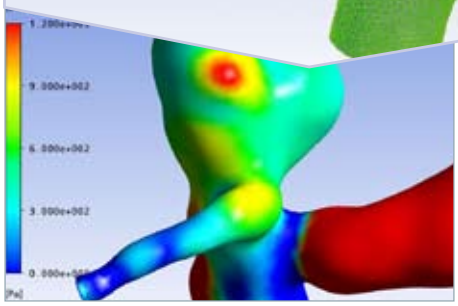
Step 1: Patient medical image

The project brings together neurosurgeons, neuroradiologists, epidemiologists, engineers, biologists and computer scientists from 32 European institutions. Its aim is to develop a usable interface for personalised risk assessment and treatment of patients with cerebral aneurysms.
The resulting infrastructure will not only support computationally demanding tasks, such as complex modelling and simulation, but will also enable access to public and protected health databases all over the world. This should promote the development of corresponding systems for other disease processes.

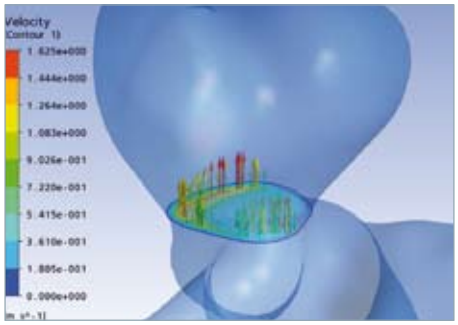
Data management

The volume of data describing human disease processes, including our understanding, diagnosis, and management of them, is growing exponentially. While this increased information allows diseases to be better understood and better treated, it presents a data-management challenge, as Derek explains: "It is often impossible for an individual,whether a clinician responsible for patient management, or a physicist or engineer developing new imaging or interventional devices, to understand and assimilate this knowledge. It has become increasingly evident that new methods are required to manage, integrate and search data so that it becomes accessible to the end user. This project was designed to address this issue.
"IDAC Ireland was chosen as a partner because of its

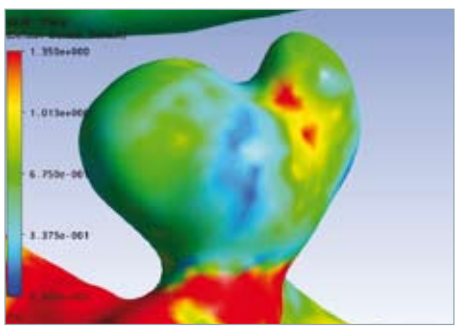




Step 5a:
Static Pressure



Step 5b:
Measurements
at the Neck



Step 5c:
Wall Shear Stress

experience in simulation of implantable medical devices and its pedigree in successful delivery of stent simulation applications to device manufacturers such as Abbott Vascular and Boston Scientific.

The project, which is in its third year of four, will deliver several integrated modules. Candidate genes associated with the disease will be identified and presented to the clinician along with the genetic history of the patient. patient risk assessment will be carried out by integrating all available information to produce a quantitative score.

This score will be used as a guideline to help determine whether or not clinical intervention is appropriate."

Patient scan data will be presented in an interactive environment allowing the clinician to visualise the blood vessel geometry.

Automated simulation tools will be presented which support the design of implantable devices and intervention planning by simulation of the structural, haemodynamic and biological response to intervention.

Delivering the simulation module

IDAC Ireland is responsible for the development and delivery of the simulation module. This module will have two distinct end-users. The first is the medical device manufacturer.

"The module will provide an expert, automated tool directly to stent designers to allow them to simulate the structural and fluid flow performance of proposed stent designs.

"New stent geometries can be uploaded and simulated for

"Simulations can also be carried out with a stent implanted to determine its effect on critical measures such as pressure in the aneurysm."

structural performance in a matter of hours, Derek states, allowing the stent designer to assess many variations quickly and cost effectively.

The effect on haemodynamics of new stent designs implanted in diseased vessels can also be assessed allowing the designers to choose stent pattern shapes which produce beneficial effects on blood flow. (See Figure 2, page 498.)"

The second end-user is the clinical end-user. Typically this would be the neuroradiologist who is treating a patient already diagnosed as having a cerebral aneurysm. The neuroradiologist must decide what treatment is most appropriate for the patient. This will depend on several factors – age, medical history, genetic profile, size and shape of the aneurysm.

"The simulation module will allow the clinician to run simulations to better understand the haemodynamics of the diseased vessel. Simulations can also be carried out with a stent implanted to determine its effect on critical measures such as pressure in the aneurysm, flow through the neck of the aneurysm, and shear stress on the wall of the aneurysm.

"This additional information should help the clinician to choose the best possible treatment plan for the patient.(See Figure 3, pages 498 and 499.) The project to date has been a great success, bringing experts from different fields and different countries together to deliver truly innovative tools which should have an impact on health care and quality of life." Φ

Derek Sweeney, BE, CEng, MIEI worked as a design engineer for GEC Large Steam Turbines in the UK and GE Aircraft Engines in the US before returning to Ireland to work for Marotta (formerly Devtec) on the design of the engine support system of the Arianne 5 satellite launcher.

He is founder and managing director of IDAC Ireland Ltd and a founding member of the Technology Network Alliance AG. IDAC Ireland Ltd, a computer aided engineering consultancy based in Dublin, has been providing simulation services to its clients in Ireland, UK and USA since 1997.