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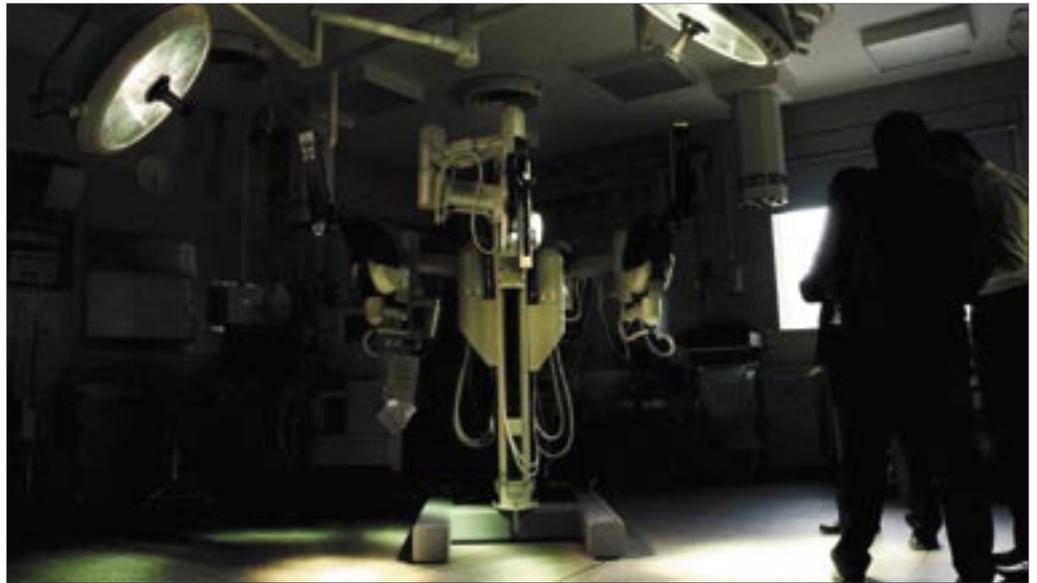
Ghost in the machine

Philip S Green has just been crowned best non-EU inventor for giving surgeons a unique level of control over their operations. Matt Williams reports

When you hear about the level of surgical precision that can be achieved by his invention, it's no surprise that American Philip S Green won his award at this year's European inventor of the year ceremony. The formal recognition of the value of his innovative surgical system might come as a relief for Green, a biomedical engineer at the non-profit research institute SRI International, but despite discussing his invention many times during the course of its development, he says that many people still fail to grasp just how powerful a tool it really is. "I would bring people into my laboratory, have them sit down at the surgeon's console, and without giving them instructions, they would just reach in and grab the handles. It was then that they would realise that it's just like doing open surgery with your hands inside the patient."

The surgical system developed by Green involves a robotic console, at which the surgeon guides a device that can perform all of the necessary surgical tasks they would normally carry out, but with much greater precision. This level of accuracy is achieved using a combination of, in Green's own words, "many things that have to be just right", in order to give the user the impression that they are themselves reaching in and using the instruments with their own hands, as in normal open surgery. It is the "normality" of his invention that Green has long been keen to stress, in particular the fact that it is a human surgeon who is guiding the robotic device. "This system is often referred to as robotic surgery, but throughout development I have tried very hard never to allow people to use this term. I call it 'telepresent' surgery because it isn't being done by a robot. People picture automatons doing the surgery without any input from humans. It's not like that. It's giving the surgeon a very powerful tool to do surgery the way he's used to doing surgery."

Remote control devices, Green explains, connect the surgeon's hand instrument in the console to the instrument tips, which are inserted through the abdominal wall, and a stereo endoscope with two optical cords connected to two monitors gives the surgeon a good three-dimensional view inside the body. From the user's point of view, it is crucial to create the sense that the robotic instrument tips are coming right out of the controllers on the console, so that as the surgeon moves his hand one way, the robotic instrument also moves instantaneously, as if it is rigidly connected. "In terms of a time lag, the system is very crisp and very precise. There are some deviations that are of more concern



The da Vinci robot in a theatre at Guy's Hospital, central London

than others, for example if you rotate the controls, much like if you rotate a computer mouse, and try to use it at that angle, you get hopelessly confused. We went to great expense to make sure that the image follows the surgeon's hand religiously. Not only does the surgeon see his instruments as he's moving them, but when he tugs on tissue or tugs on a suture, he feels a resistance in the hand controls. This is very important."

It is this combination of accuracy and attention to detail that forms the essence of Green's surgical system. However, there are other more complex features that add to the value of his invention. Examples include the ability to magnify the image on the console while minimising the motion of the surgeon, which as Green goes on to explain, enables the surgeon to perform some impressive tasks. "With this, the surgeon can suture a blood

vessel only a few millimetres in diameter as if he were working on a garden hose. In addition to this, when working on a very fine scale, some surgeons have hand tremors. We can tune this out. This

way, the surgeon's hand may tremble but the instrument doesn't. This is possible using electronics. A tremor has a characteristic rhythm, and if you know what that rhythm is, you can put an electric filter into the control system that simply has a notch in it that cuts out the movement."

Green's telepresent system, which has been authorised by the US Food and Drug Administration for use in general laparoscopic surgery, as well as cardiac, chest, urological and gynaecological procedures, was given the name 'da Vinci surgical robot' in honour of the Italian artist and inventor whose sketches of an automaton were discovered in the last century. In presenting him with this award, the EU has now also acknowledged Green's significant contribution to the world of science. ★

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