



A virtual liver, a better chance of life

Surgeons can now use 3D, accurate images of the liver to rehearse keyhole tumour removal before real surgery – reducing the risk to the patient and enabling them to take expert advice.

EUREKA project E! 3184 – Odysseus has developed systems to construct 3D images of individual patients’ livers, with their tumours or other pathologies, from MRI or CT-scans. The reconstructions can be transmitted to external experts in any location, for consultation in real time just before surgery. Collaborative decisions can be made and optimal therapy planned with the best possible diagnostic support, before real surgery is attempted. Simulation of laparoscopic and robotic surgery, with tissue resistance, can be used either to practise the exact surgery proposed for an individual patient, or also for training several surgeons simultaneously.

Medical imaging of organs and tissues has contributed greatly to diagnosis and therapy planning, especially in the treatment of cancers, which are the major cause of deaths worldwide. However the 2D scanning images possible until now have been difficult to interpret, and it has not been possible to consult others who are not present in person. The EUREKA project Odysseus has developed software for 3D-imaging of the blood vessels of a patient’s liver which has materially advanced medical

understanding of how the liver is segmented. Until now, liver surgery has been based on the anatomy classically described by Couinaud in 1957. But the 3D modelling has shown that up to 50% of patients have a significantly different liver structure from the Couinaud description. “Thanks to the 3D modelling,” says Professor Luc Soler of the Institut de Recherche pour les Cancers de l’Appareil Digestif (IRCAD),

developed as a result comprise a whole set of interrelated technologies which together will help medical specialists to take the best informed decisions on diagnosis and treatment.

Virtual Patient Modelling (VR-Anat, formerly known as 3D-VPM) uses patient-specific data to enable pre-operative assessment. Diagnosis and Virtual Planning (VR Planning, formerly

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Multiple skills

But this is only one part of the achievements of Odysseus. The project brought together partners with expertise in tumour detection, endoscopy, virtual simulation and specialised software for image transmission and reconstruction at a distance, in real time. The products

3D DVP) is software which enables navigation and tool positioning within 3D images that can be reconstructed from any multimedia-equipped computer. These two sets of software were developed by IRCAD in collaboration with the French Institut National de Recherche en Informatique et Automatique (INRIA), and tested in five hospitals in France, Switzerland and Canada.

France Telecom, also a partner in



the Odysseus project, developed the communication system called Argonaute, allowing several practitioners in different places to interact and advise on the images simultaneously. The unlimited laparoscopic simulator (ULIS) and the robotic surgery simulator (SEP Robot) added realistic physical properties of texture and tissue resistance to the 3D model of the patient, allowing surgical intervention to be simulated before real surgery. These simulations were developed respectively by the German endoscope manufacturer Karl Storz and by SimSurgery of Norway. Luc Soler holds that it is now difficult to tell the difference between photos of real surgery and the simulator images.

Reaching the market

The products developed during

set up to take forward production of the ULIS laparoscopic simulator, and Karl Storz is expecting to market it before the end of 2009. SEP Robot was added to the SimSurgery's current Surgical Sim Education Platforms. France Telecom software has been installed in all French regions and will enable surgical teams throughout France to work together. France Telecom has also set up a new commercial system with Orange for medical data communication and distance working.

Better prospects for patients

The products of Odysseus will make a very significant contribution to the accuracy of tumour diagnosis in the liver and its treatment. Once trials and validation are complete, their use will enable more accurate diagnosis of secondary liver tumours so they can

Odysseus research has led to a new major research project, Passport, within the EU Seventh Framework Programme. FP7 includes the Virtual Physiological Human initiative, developing tools for modelling and simulation of most human physiology and disease-related processes. Passport, partially funded by the European Commission, will extend the Odysseus prototype software to a professional standard, achieving CE marking in 2010. Passport will add patient-specific biological, mechanical, dynamic and appearance modelling to the geometric modelling. Through Passport, IRCAD has already developed the rendering software further (VR Render) and made it freely available on the internet.

Professor Soler greatly values that

In the future this will reduce secondary tumours in the liver, and it will reduce the segments we have to remove. In the end it will save more patients.

Luc Soler - IRCAD, France



the Odysseus project are already contributing to new employment and this will increase once trials are complete and production is under way. IRCAD is now working with the major services company Altran to develop an online service based on the patient modelling and surgical planning systems, VR Anat and VR Planning. A new company, Digital Trainers, has been

be removed completely; and reduce the size of liver segments that need to be resected. Because the success of liver surgery depends on the minimum volume of liver that can safely remain after surgery, accurate knowledge of the topology of the individual liver should significantly increase the number of patients who are eligible for surgery.

Odysseus was a EUREKA project. It was not instrumental in finding partners, as they were already known to each other, but it did enable development of the project with just a few partners, allowing flexibility and efficiency.

Project participants:
France, Germany, Norway

Budget: 7.11 MEuro

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