Tablet PC Supports Liver Surgeons
New app from Fraunhofer MEVIS tested for the first time during an operation in Germany

Bremen, August 20, 2013. Until now, surgeons have had to memorize the precise location of important blood vessels in organs and where tumors could likely be found and need to be removed. A new app for tablet computers developed by Fraunhofer MEVIS in Bremen could support surgeons in the future and help them reduce the rate of complications during operations. The system has recently been tested for the first time in Germany. On August 15, the surgical team at the Asklepios Klinik Barmbek in Hamburg successfully tested the app during a liver operation.

A liver cancer operation usually lasts many hours because the organ is difficult to operate. It hosts a branching vessel structure through which one and a half liters of blood flow every minute. If a surgeon makes a cut in an inappropriate place, this puts the patient at risk of severe blood loss. In addition, doctors must ensure that the patient retains enough organ volume for survival and that this volume is sufficiently supplied with blood. To accomplish this, doctors need to know as accurately as possible both before and during an operation where blood vessels inside the organ are located.

The new tablet app from the Fraunhofer Institute for Medical Image Computing MEVIS in Bremen promises to deliver this support. It is based on the established MEVIS software for liver operation planning that is employed in clinics worldwide and has been used for more than 6000 patients. Based on 3D x-ray images, the software can reconstruct the locations of blood vessels in the liver for each patient. Before an operation, surgeons can then precisely plan how and where to place the scalpel to most effectively remove a tumor.

However, there are limitations: doctors usually have little opportunity to view the software images during surgery and compare the surgical situation with planning data. Some surgeons even print out images to take into the operating room. "With our app, the entire set of planning data can be shown directly on the operating table" said MEVIS computer scientist Alexander Köhn.

At the intervention in Hamburg, the clinicians used a further feature of the new app. With the integrated camera, the tablet could film the liver during the operation. The app then superimposed the planning data – a branched network showing the vessel system in different colors. "Using this function, we can virtually look into the organ and make the tumor and vessel structures visible" said Prof. Dr. Karl Oldhafer, Chief of the Department of Surgery at the

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Asklepios Klinik Barmbek in Hamburg. This simplifies comparison to determine whether the intervention has gone according to plan. "With this new technology, we are able to better

implement computer-supported operation planning for tumor removal" remarked Oldhafer. "The method has great potential. We imagine using it for operations on other organs, such as the pancreas."

Alexander Köhn developed the first version of the app with doctors at the Yokohama City University Hospital The app was test there at the end of 2012 for the first time during an operation. "The Japanese surgeons were very impressed by the capabilities of the system" said Köhn. "They hope that the app will help reduce complication rates and shorten hospital stays." For future interventions, the app offers the following capabilities:

- By simply marking the touchscreen, doctors can measure the length of a vessel to be removed. This helps the doctor estimate whether the remaining ends can be sewn together or whether a new piece of vessel must be inserted.
- After the surgeon removes certain vessels, he can remove them on the app screen with a virtual 'eraser'. The separated vessels disappear from the screen and let the doctor view underlying structures.
- If, during the operation, a tumor is judged to be larger than at first thought, surgeons must make snap decisions. The MEVIS app can also help here. If additional vessels must be removed, the app calculates which parts of the liver will no longer be sufficiently supplied with blood. This lets the surgeon better estimate whether the remaining organ volume is large enough for the patient to survive.

For many years, Fraunhofer MEVIS has developed procedures to bring image-based planning information into the operating room and make them directly accessible to surgeons. The challenge is that a large amount of data must be efficiently reduced so that the surgeon is always supplied with the most recent and most important information. To allow doctors to request data quickly and selectively, researchers are developing novel interaction strategies. Tablet computers such as the iPad are only one way to implement these ideas. Other MEVIS teams are working to develop navigation systems similar to those found in cars, to project planning data directly on the organ or surgical drapes, and to use gestures to recall desired information.