High-resolution depth measurements in digital microscopic surgery

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Abstract

Fully digital microscopes are becoming more and more common in surgical applications. In addition to high-resolution stereoscopic images of the operating field, which can be transmitted over long distances or stored directly, these systems offer further potentials by supporting the surgical workflow based on their fully digital image processing chain. For example, the image display can be adapted to the respective surgical scenario by adaptive color reproduction optimization or image overlays with additional information, such as the tissue topology. Knowledge of this topology can be used for computer-assisted or AR-guided microsurgical treatments and enables additional features such as spatially resolved spectral reconstruction of surface reflectance. In this work, a new method for high-resolution depth measurements in digital microsurgical applications is proposed, which is based on the principle of laser triangulation. Part of this method is a sensor data fusion procedure to properly match the laser scanner and camera data. In this context, a strategy based on RBF interpolation techniques is presented to handle missing or corrupt data, which, due to the measuring principle, can occur on steep edges and through occlusion. The proposed method is used for the acquisition of high-resolution depth profiles of various organic tissue samples, proving the feasibility of the proposed concept as a supporting technology in a digital microsurgical workflow.

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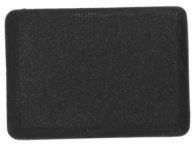

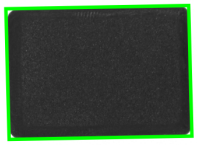

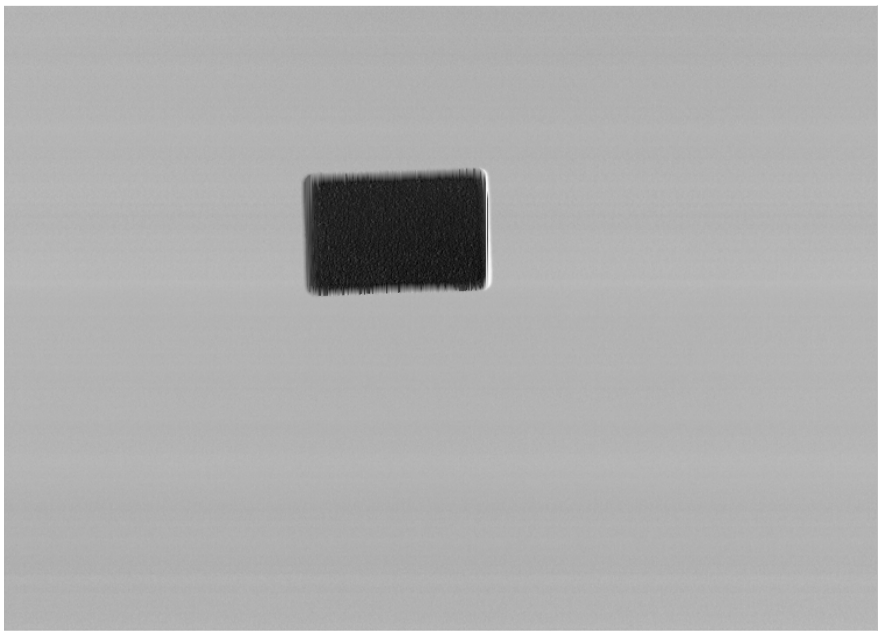

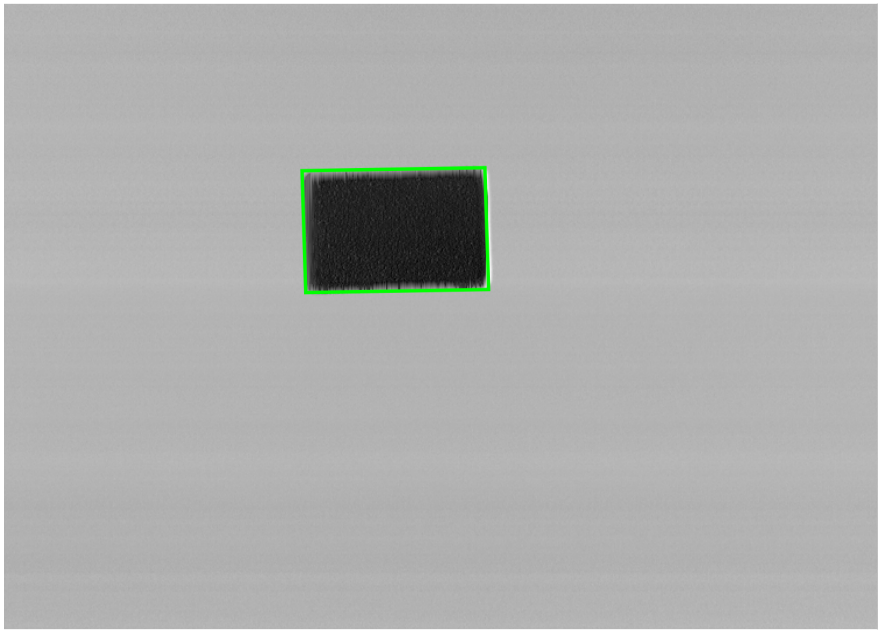

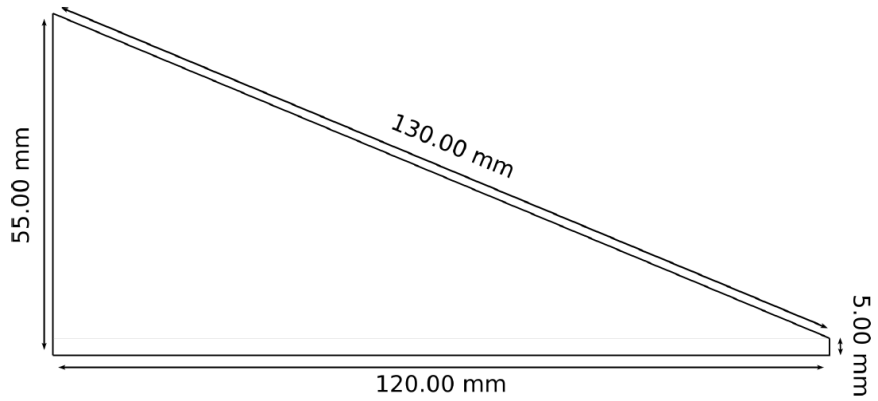

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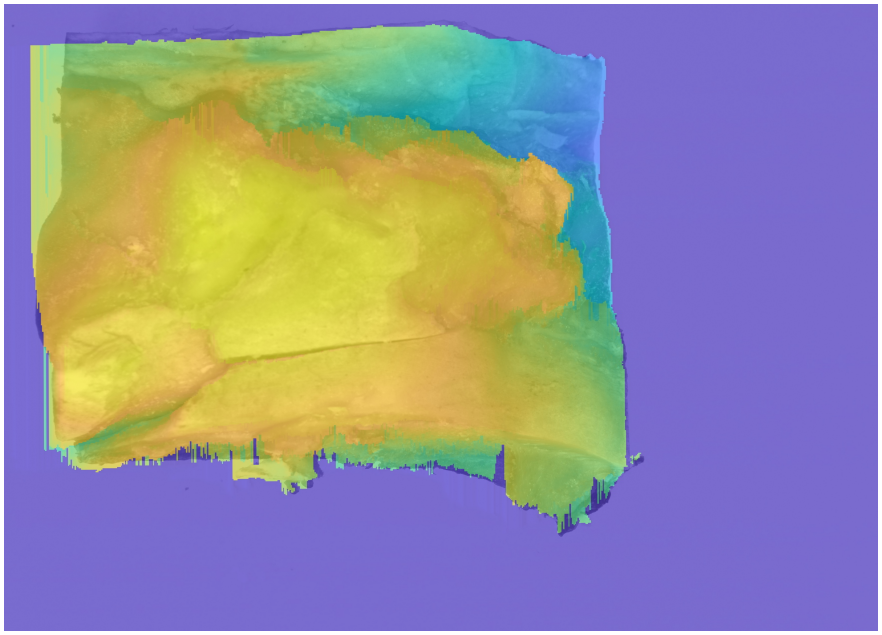

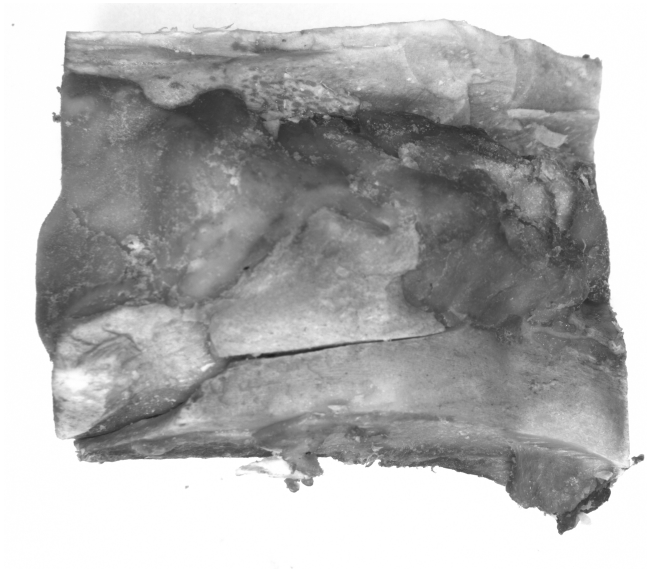

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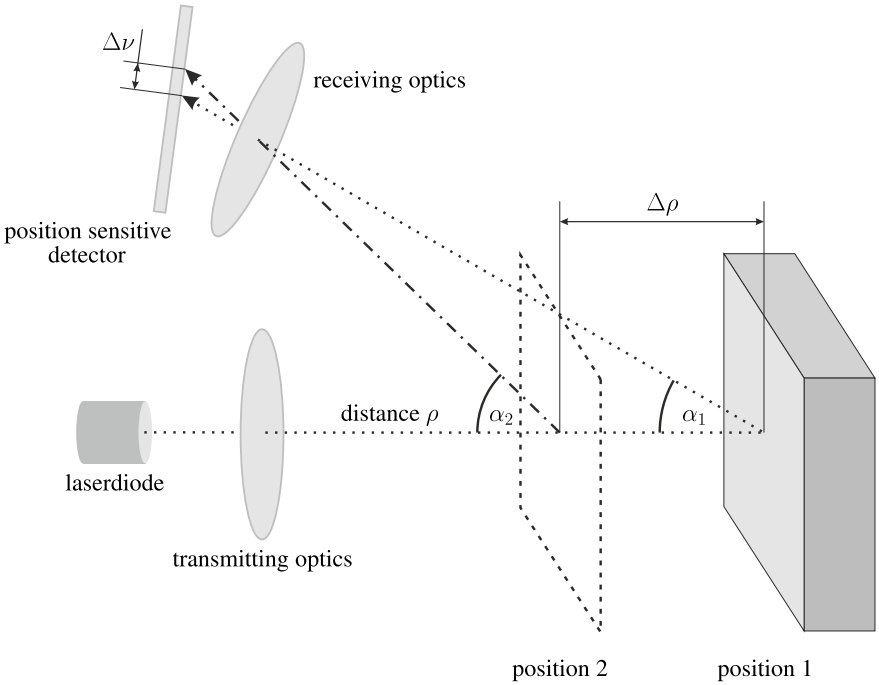

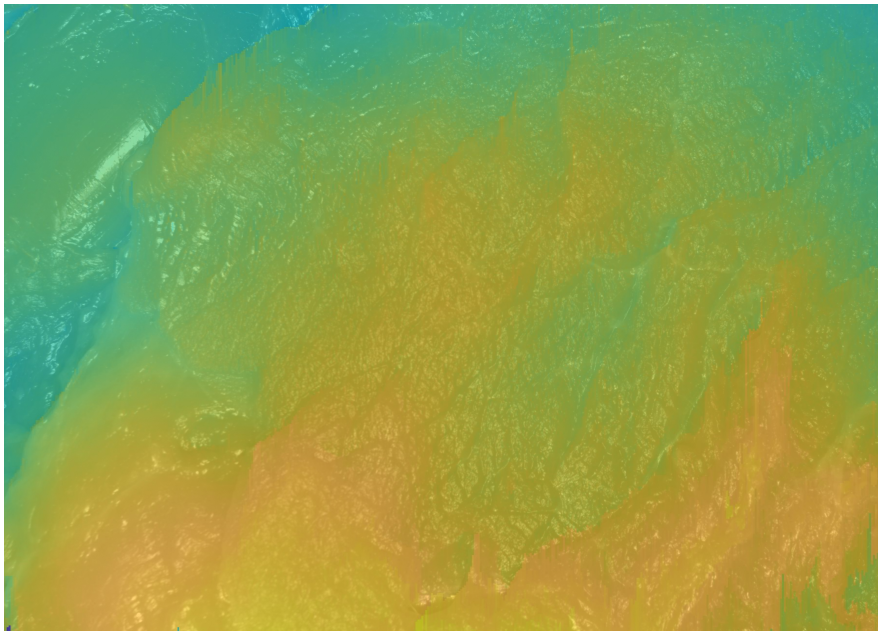

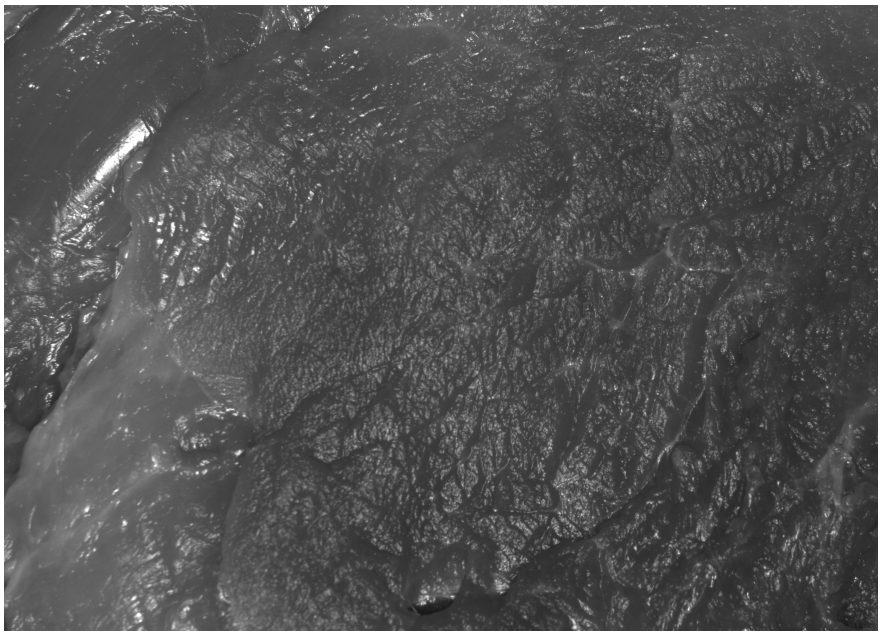

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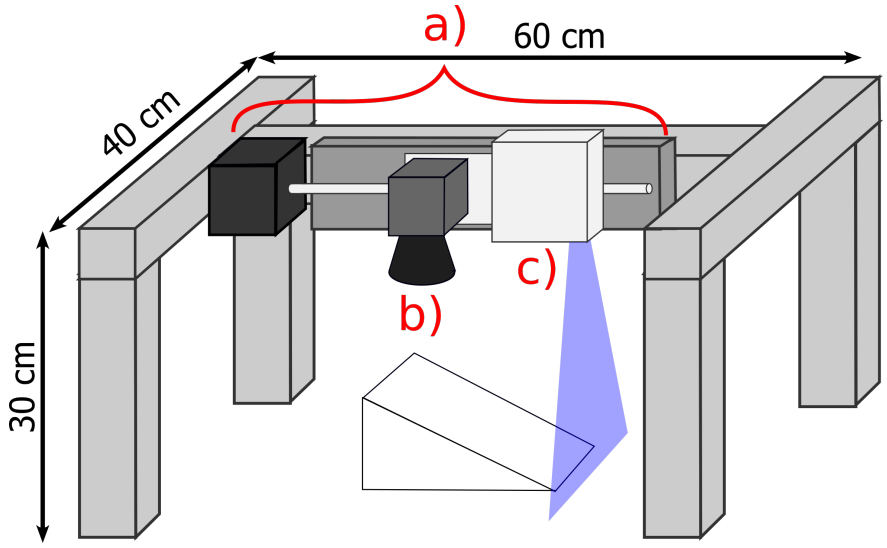

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