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Abstract-Title:
UML BASED MODELING OF MEDICAL APPLICATIONS WORKFLOW IN MAXILLOFACIAL SURGERY

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Abstract-Text:
This paper presents our research in medical workflow modeling for computer- and robot-based surgical intervention in maxillofacial surgery. Our goal is to provide a method for clinical workflow modeling including workflow definition for pre- and intra-operative steps, analysis of new methods for combining conventional surgical procedures with robot- and computer-assisted procedures and facilitate an easy implementation of hard- and software systems. The Unified Modeling Language (UML) is a family of graphical notations, backed by single
meta-model, that help in describing and designing software systems, particularly software systems built using the object-oriented (OO) style. UML was developed by the Object Management Group (OMG) as an open standard. UML workflow activity diagrams are widely used as a representation language for workflows. Activity diagrams represent the business and operational workflows of a system and are typically used for business process modeling, for modeling the logic captured by a single use case or usage scenario, or for modeling the detailed logic of a business rule. In our approach, UML is used to describe complex systems like surgical robots or hand scanners used for patient registration in an intuitive way. Modules within the workflow can be categorized by image acquisition, data modeling, operation planning and simulation, and supervision of surgery or intra-operative execution respectively. In maxillofacial surgery the quality of the surgical outcome mainly depends on the experience of the operating surgeon. In the case we consider, the surgeon is supported during surgery with a complex system which uses a preoperative treatment plan, an infrared navigation for monitoring both the patient and the robot, and a surgical robotic system. The robot is used as a tool for registration and for maintaining the desired bone repositioning. In the intra-operative setting, after the registration is completed and until the bone is repositioned, the surgeon performs the surgery in conventional mode. The robot is used only in the repositioning phase so as to reduce the risk and make the system intrinsically safe. The hand-held laser scanner is used for patient registration in the operation theatre and provides the position and orientation of the patient. The accuracy of the registration has much influence of the total accuracy of the navigation system. The head of the patient is scanned intra-operatively and the information is matched with the surface data of the CT/MRT acquired pre-operatively. To compensate movements of the patient's head during the scan-process a tracking-body, such as a splint, is attached on the maxilla. Each pre-, intra- and postoperative step and its participation can be drawn in an UML-activity diagram in a multidimensional view. More activities of complex activity diagrams can be decomposed in new sub diagrams and activities occurred in the same time can be drawn parallel.