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In conventional Image guided surgical, information obtained with pre/intra operative three dimensional imaging devices (CT, MRI, US etc.) are used to localize pathological area and to navigate surgical operation such as tumor resection. In principle, the three dimensional volumetric image should be registered to patient coordinates using three dimensional position tracking system such as optical tracking system and electromagnetic tracking system. This information can be used to control surgical robotics. Because of errors originated from three dimensional position tracking, image registration, and special resolution, in particular limitation of slice thickness, resultant accuracy of surgical navigation is at most as large as a few mm. In addition, living organs deforms due to various reasons. Preoperative image based surgical navigation system has is accuracy limitation in principle. Additional intra-operative information can be used to overcome the limitation. For example, cortical and sub-cortical electrical stimulation are conducted to identifying important functional areas such as motor and speech center while registering the three dimensional location of the stimulating points are registered to the conventional navigation system to understand functional localization.

This information can be also used for surgical navigation. Various physiological information such as oxygen saturation, spectroscopic property, tissue pH, tissue perfusion, concentration of a specific chemicals, and local temperature can be measured using advanced biomedical instrumentation techniques. These kinds of physiological information at local area can be mapped to the anatomical information used for surgical navigation to help surgeon's intra-operative determination of pathological/healthy area in surgical field. This enables target therapy of the pathological area that can keep the healthy tissue intact. It leads to realization of minimally invasive therapy.

In this lecture, I will briefly introduce biomedical instrumentation technologies that can be used intra-operatively, fusion with surgical navigation system, and use of the integrated information to control surgical robot. Recent works in the field of surgical robotics and computer aided surgery will be discussed.



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