Image and treat methods in the mid IR

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Thermal imaging has the potential be a powerful tool for medical applications. Throughout the years, Thermal cameras became much less expensive and much more portable. The images have very good resolutions both spatial and thermal. The acquisition rate is real time. These characteristics enable them to be diagnostic tool at the point of care. However the temperature elevation they capture is not specific and can be related to either a benign inflammation or a malignant tumor. The images collected are of the surface they see and the source of temperature is not necessarily known.

We have been working in our lab on different directions for creating active thermal imaging that can solve this crucial drawback. A first direction we have taken is adding another laser source in the visible near IR range which can penetrate rather deep under tissue surface. This laser is absorbed in the different components of tissue and is chosen to be absorbed in specific components in tissue such us oxy and deoxy hemoglobin. Those can relate to higher absorption of oxygen rich blood as a measure for angiogenesis activity in a suspected tumor area. It can also relate to tissue vitality in the area of implanted tissue after burns. We have developed an algorithm that can map and measure the levels of the oxy and de-oxy hemoglobin in areas under investigation and test it in experimental set-ups.

Another research direction we have taken is the addition of super-paramagnetic nanoshells that specifically bind to tumor areas through conjugated antibodies against the tumor surface markers. Taking advantage of controllable temperature elevation of those nanoshells under the application of external alternating magnetic fields enables us to image those nanoshells and relate them to a tumor location. This done through an algorithm we developed that connects between the surface thermal images and the heat source location deep under tissue surface (up to about 15 mm). A further alteration of the external field enables higher temperature elevation that can be controlled to be confined and create specific local necrosis of the tumor. This is basically an “Image and treat method” at the point of care in a minimal invasive manner.

To enable treatment not only under visible tissue surface, we have developing a coherent IR bundle that can be used for remote thermal imaging. This bundle can be inserted through working channels of flexible endoscopes and be a tool of minimal invasive detection, treatment and real time feedback within body cavities.