# *High-Contrast Lymph Node Detection with the Infrared Tissue Imaging System (ITIS)*

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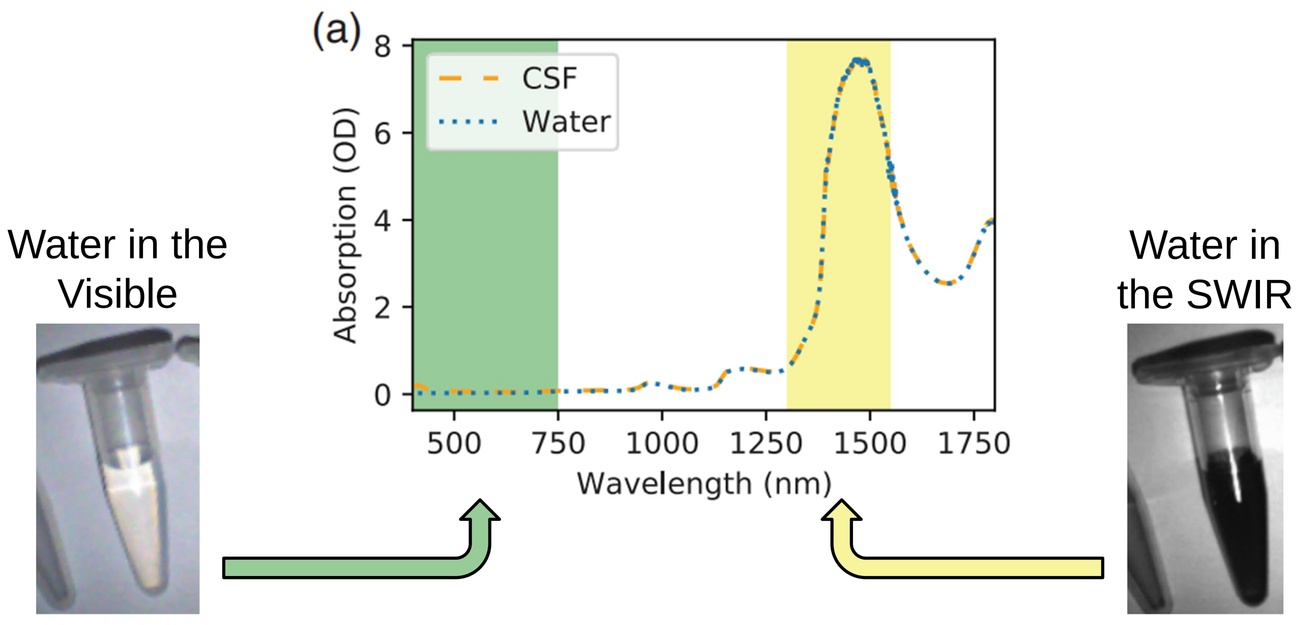
## Introduction

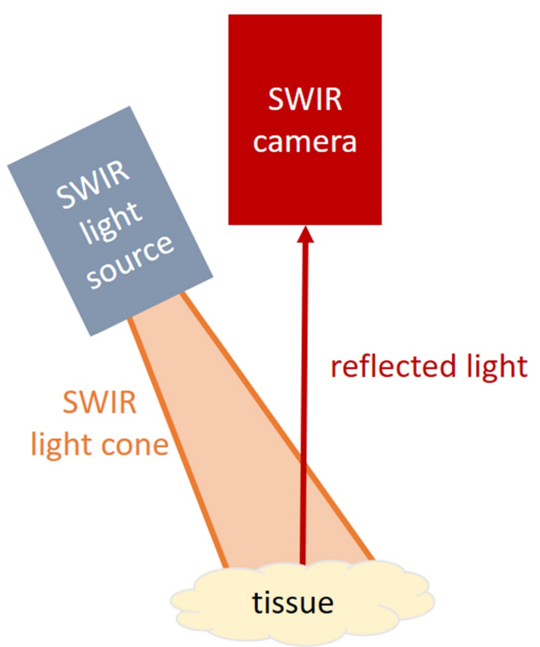
### In certain regions of the shortwave infrared (SWIR; 1000 to 2000 nm) light is highly absorbed by water



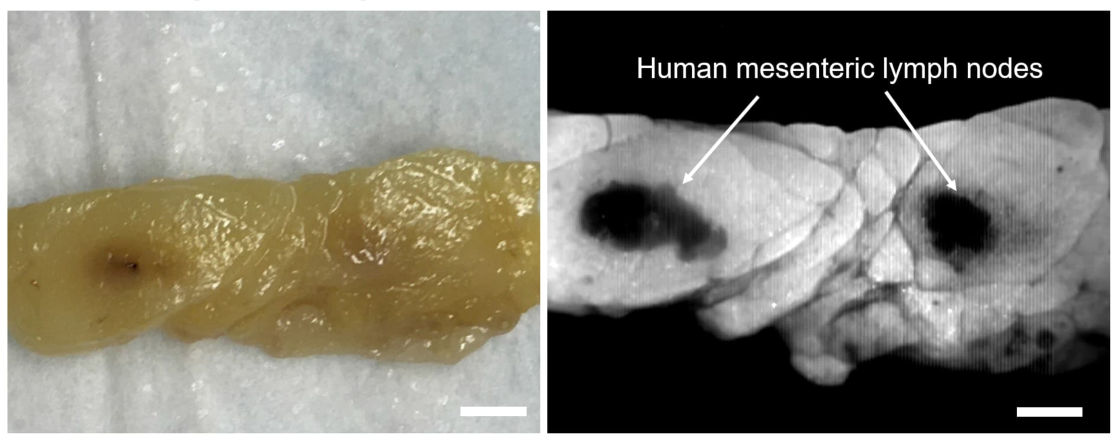

The colored bands in the spectra show the wavelength range for the illumination of the images. The green (left) wavelength range is located in the visible where water appears translucent. The yellow (right) wavelength range is located in the SWIR at a point where most of the light is absorbed by the water making it appear dark. Source: [1].

### Lymph node detection is currently challenging and can be improved with SWIR reflectance imaging

Lymph nodes are important for staging cancer [2,3], but they show low contrast in the visible [4,5].




Illumination and detection of the system. No contrast agents are required.




Hemorrhagic region in a human mesentery specimen under SWIR-OPI (right) and a regular imaging system (left). Scale bars are 5 mm. Pictures from the Belcher group (MIT), see [4].

## Aims and approach

**System prototype**
- Selection of wavelengths for optimal contrast
- Light source definition
- Software design for integration of hardware and user-friendly experience
- Validation in the lab with animal tissue
- Preparation for the clinic, e.g., hardware packaging

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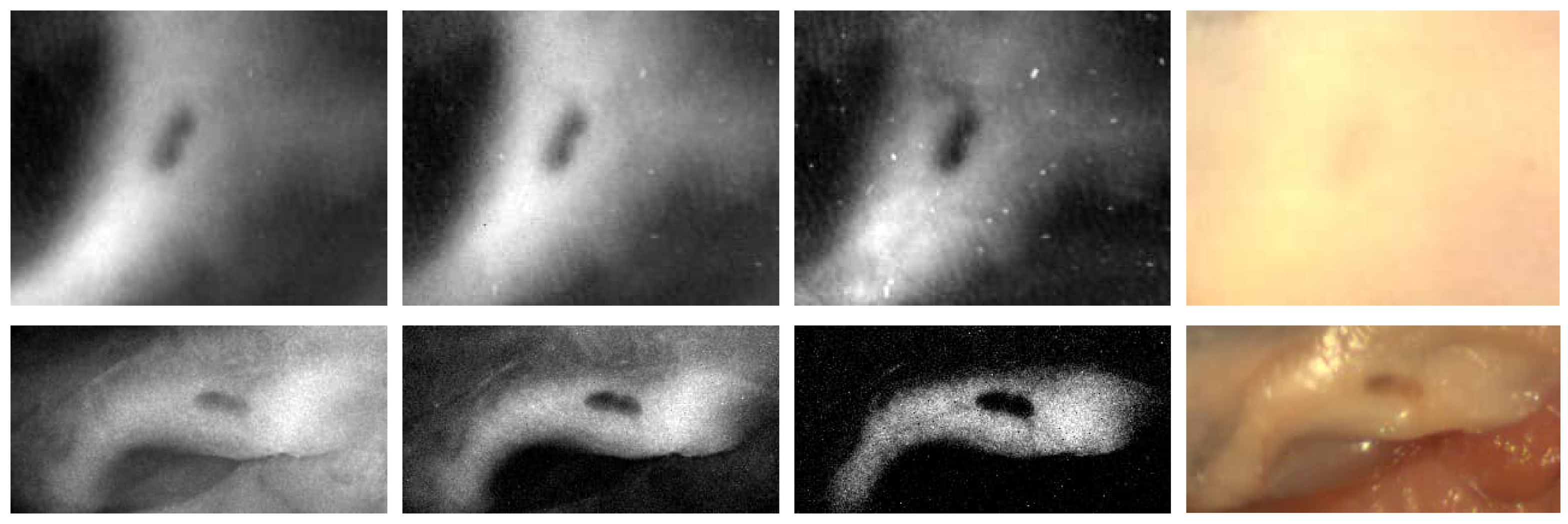
**Validation in the pathology suite**
- Imaging human tissue in larger numbers
- Assessment of true/false positives/negatives

→

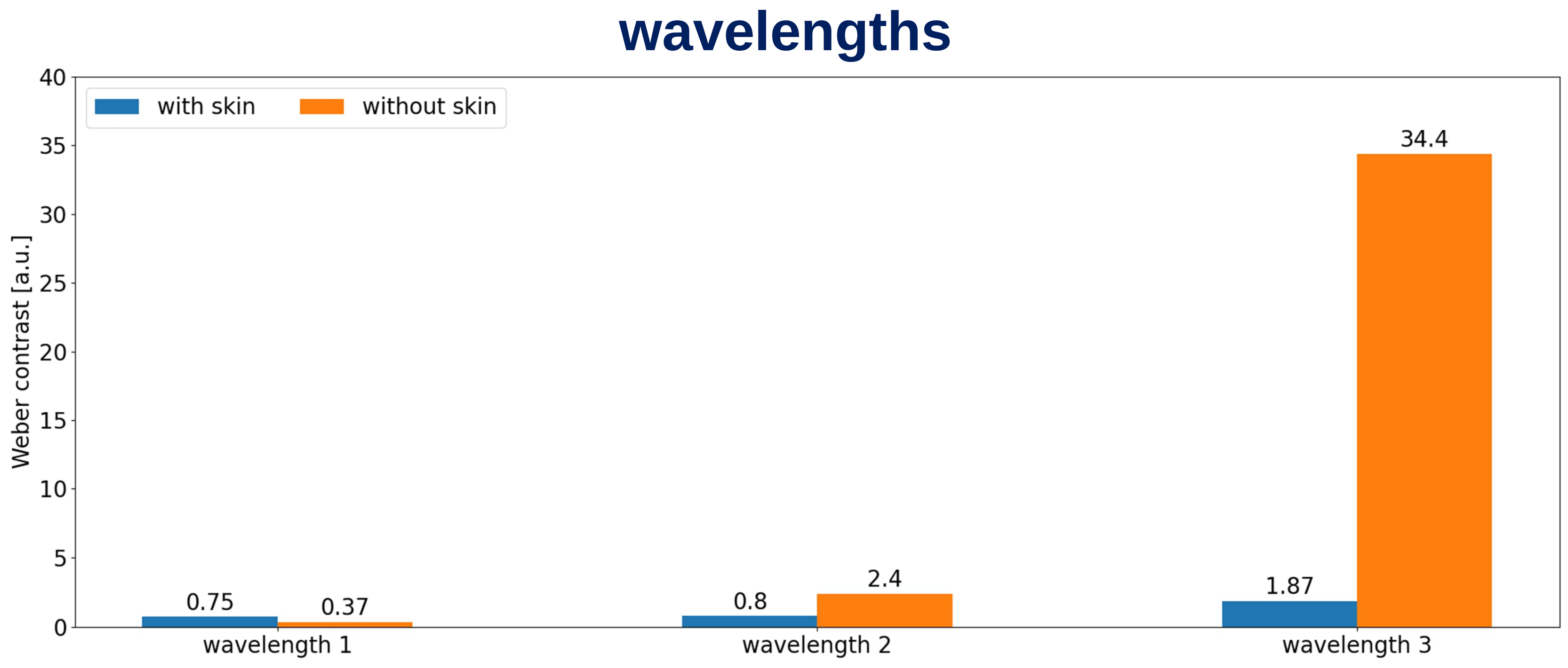
**Use in the operation room**
- Back-table solution for fresh tissue
- Open surgeries (hand-held device)
- Minimally invasive surgeries (endoscopic device)

## Contrast of tissue is dependent on the SWIR wavelength



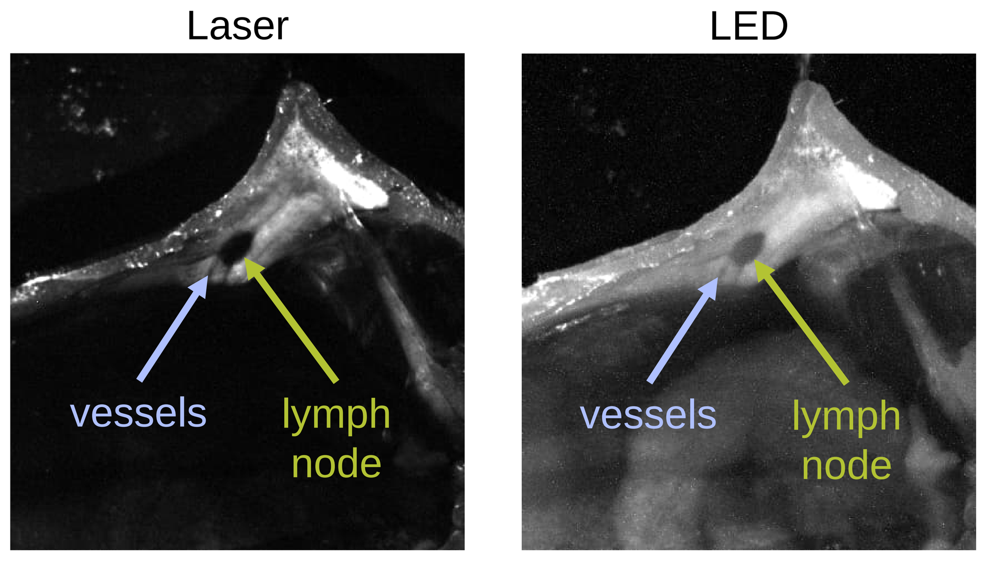

The panel shows the inguinal lymph node of a mouse when illuminated with different wavelengths in the SWIR and with visible light. In the top row, the skin of the mouse was intact. In the bottom row, the skin of the mouse was removed. The position of the sample changed but the same lymph node was imaged in both situations.

### Skin reduces the contrast by a magnitude at certain wavelengths




The Weber contrast between mouse lymph node and surrounding tissue is plotted. The blue bars show the achieved contrast with skin while the orange bars depict the contrast without the skin.

## Lasers can yield a higher contrast compared to LEDs

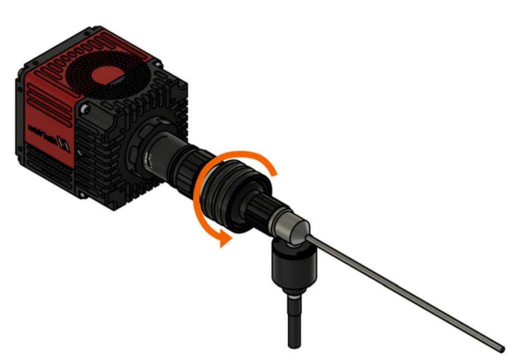



Mouse inguinal lymph node (green arrow) in surrounding white adipose tissue (skin removed) illuminated with two different light sources. Some vessels running to/from the lymph node can be seen (blue arrow). Laser and LED are at approximately the same wavelength.

## Determination of system performance in clinical samples

Within a preclinical study, different types of tissue will be imaged in pathology and the system will be characterized based on its performance. The following step is to move the system into the operating room, first as a back-table solution and eventually as an endoscope.

## Future perspectives



Endoscope-based design. Source: [1].

- **Use intraoperatively with**
  - a handheld device
  - an endoscope
- Identification of other target structures

## References

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