MIT Media Lab | Camera Culture

guysatat@media.mit.edu

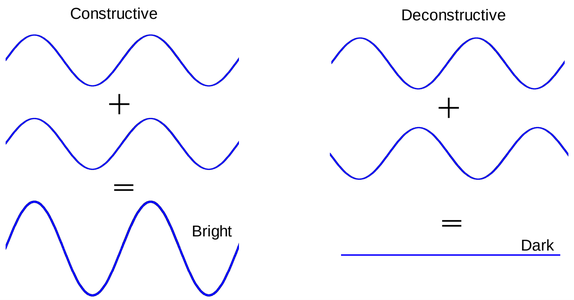
Skin Perfusion Photography

Measuring blood flow into skin tissue using computational photography

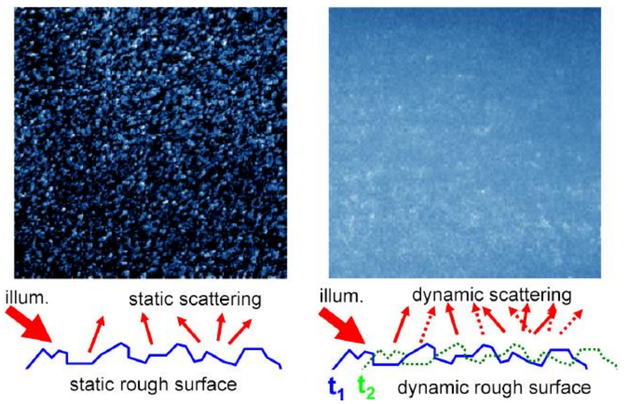
Guy Satat, Christopher Barsi, and Ramesh Raskar

ICCP 2014

Wave Interference

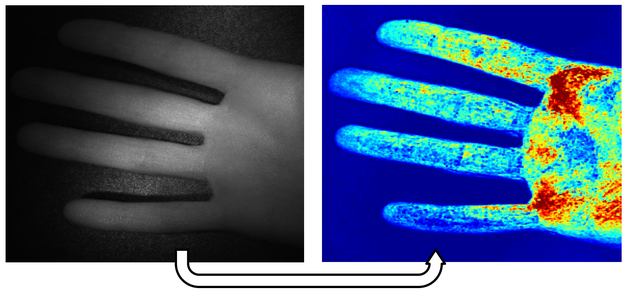


Speckle and Movement



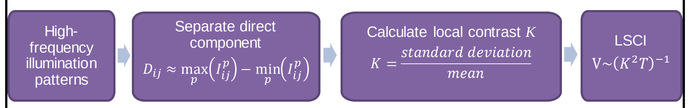
- Interference from random, static surface (left).
- Moving surface (right) reduces contrast.

Laser Speckle Contrast Imaging (LSCI)

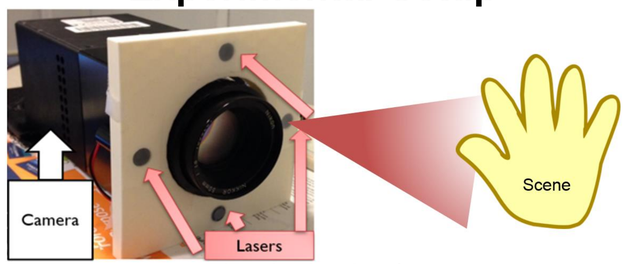


- Compute blood speed (V) from speckle interference.
- Conventional method corrupted by volume scattering.

Computational Pipeline

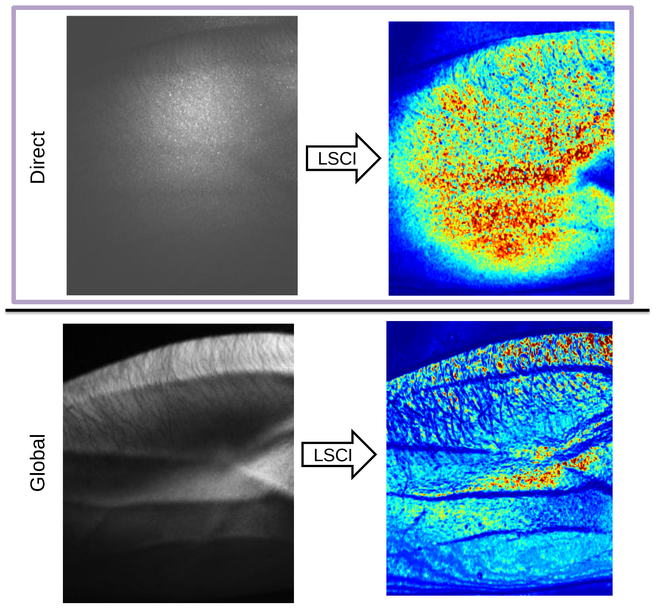


Experimental Setup



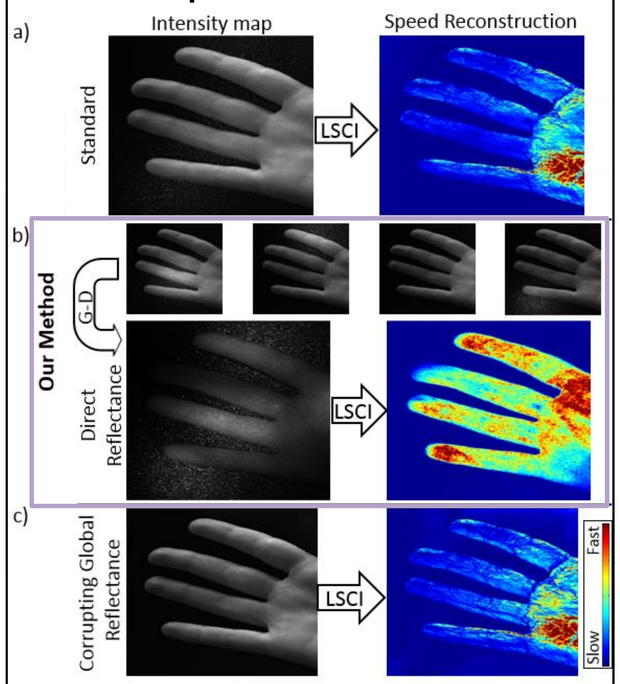
- Camera synchronized to four laser sources.
- Reconstruction occurs post process.

Information in Global and Direct



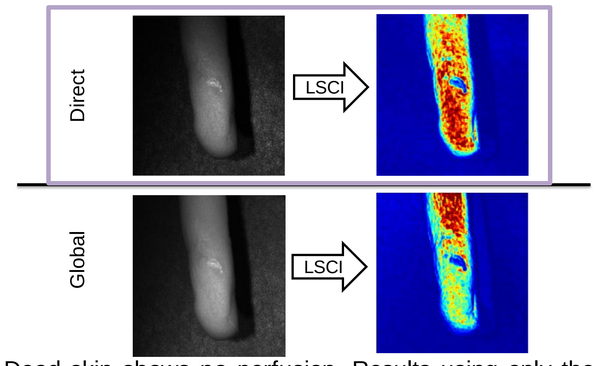
- **Top**: Direct component shows uniform perfusion in arm.
- **Bottom**: Global component contains no perfusion information, but the subsurface scattering instead.

Experimental Results



- Standard method (a) corrupted by underlying tissue.
- Our method (b) separates global (subsurface) light from the skin to reconstruct improved perfusion map.
- Global component (c) contains depth information.

Validation on Skin Burn



Dead skin shows no perfusion. Results using only the direct component (**top**) shows uniform perfusion around the burn.

How do we compute blood flow speed maps?

Perfusion is the process of delivering blood into tissue. Measuring skin perfusion is important for wound and burn estimation, and for monitoring plastic and reconstructive surgeries.

Here, we integrate computational photography with skin perfusion measurements via laser speckle contrast imaging (LSCI). By recording multiple images, we compute the direct scattering of laser light from the skin and eliminate unwanted scattering from the underlying tissue. Our method holds promise for many applications of precise analysis of *in vivo* blood flow.