Mobile Perfusion Analysis

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Goal

Generate an integrated software-and-hardware solution that allows a clinician to extract a usable metric assessing local blood flow using a mobile device.

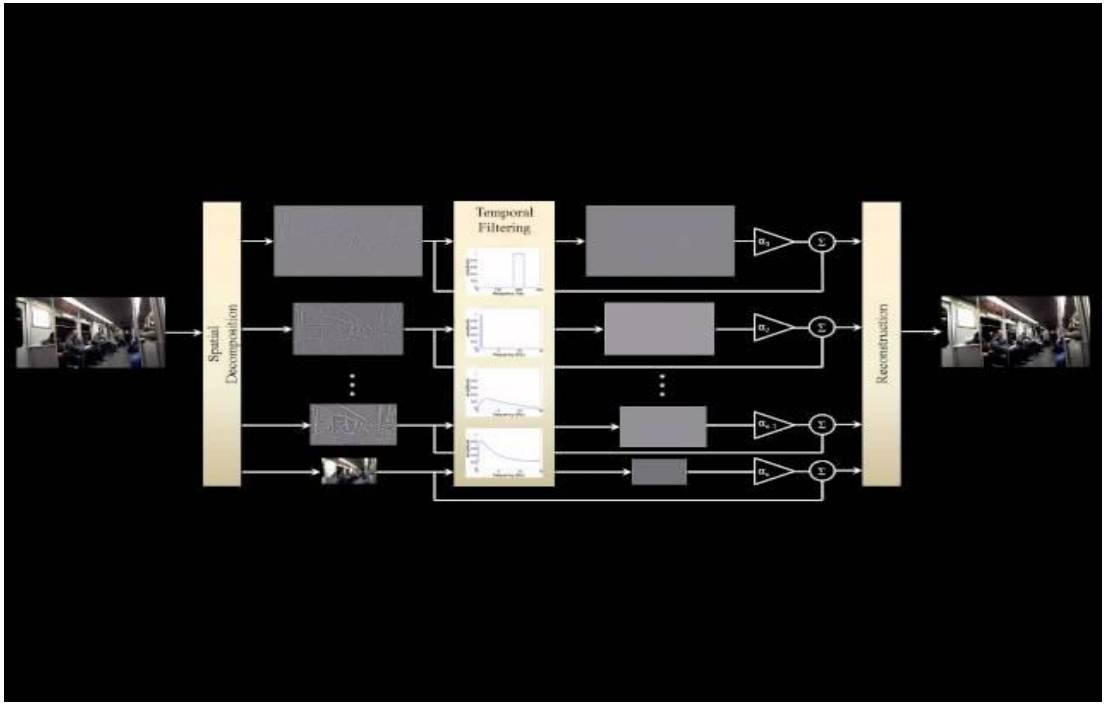
Relevance

Measures of local blood flow (perfusion) can help characterize healing of chronic wounds and assist physicians in developing appropriate treatment plans for patients. Current methods are expensive, inaccessible, and inefficient. Consequentially, wound prognosis is often poor in quality and can necessitate skin grafts, amputation of the limb or even death.

Technical Approach

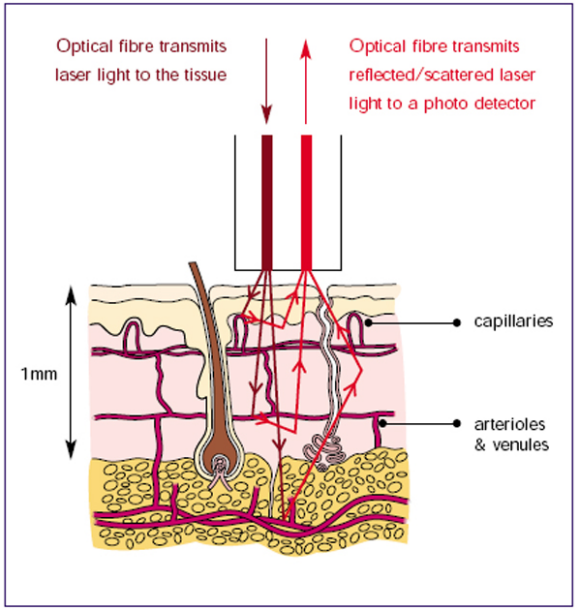
- Laser doppler imaging (LDI) is able to provide a measure of relative perfusion using a series of single point velocity readings.
- Using LDI as the ground truth, we seek to establish the feasibility of using Eulerian Video Magnification (EVM) in assessing perfusion.
- The temporal change in brightness/intensity of the RGB channels in the EVM output might provide some measure of perfusion (other metrics might come to light with further research on this topic).
- We will analyze and assess the correlation between perfusion assessed using EVM against the ground truth from LDI.

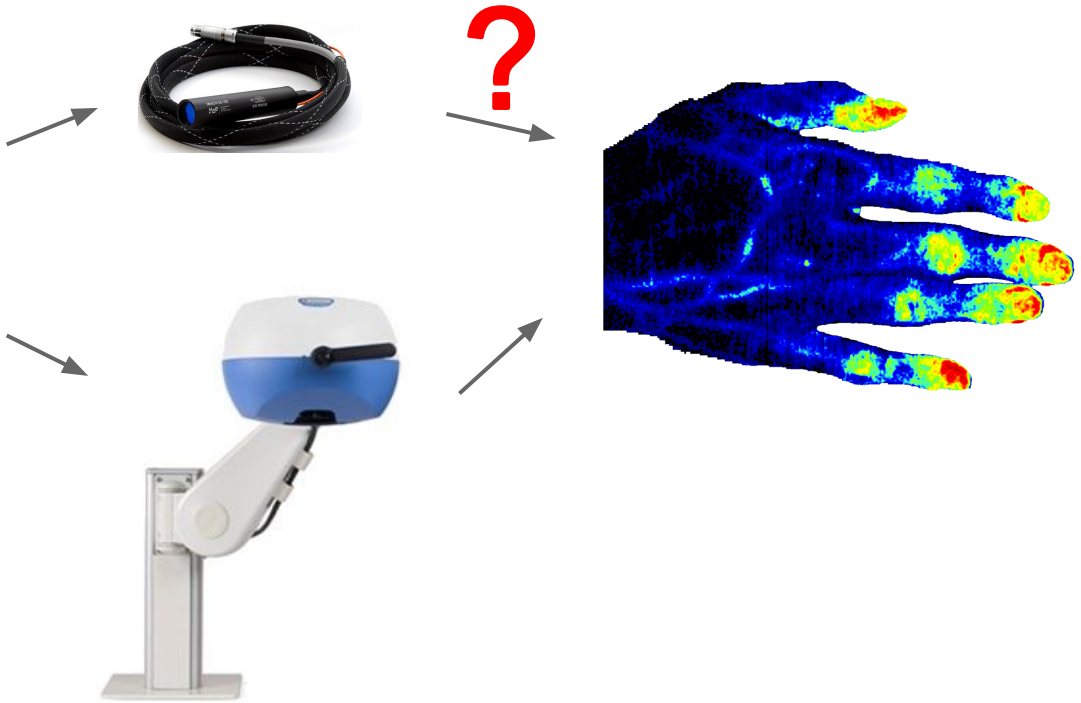
Eulerian Video Magnification



Courtesy of CSAIL at MIT (http://people.csail.mit.edu/mrub/vidmag/)

Laser Doppler Velocimetry





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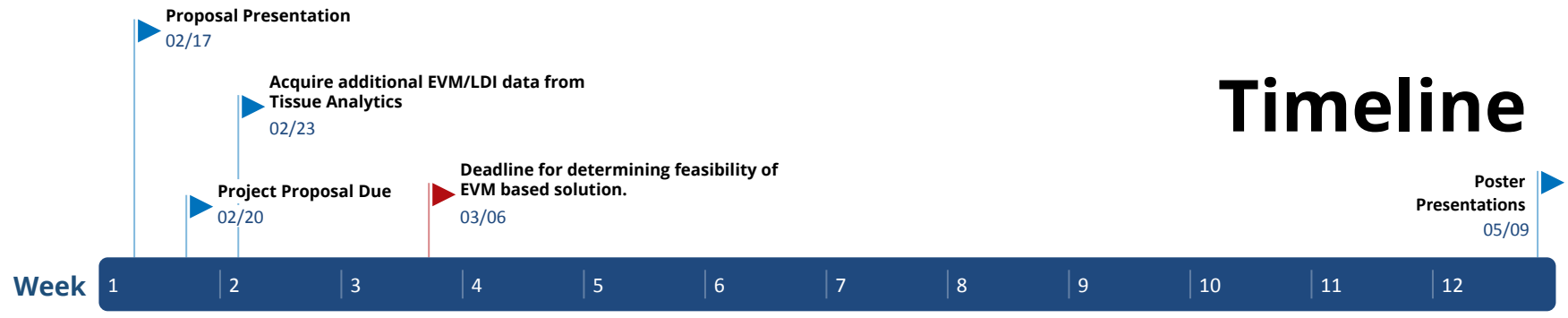
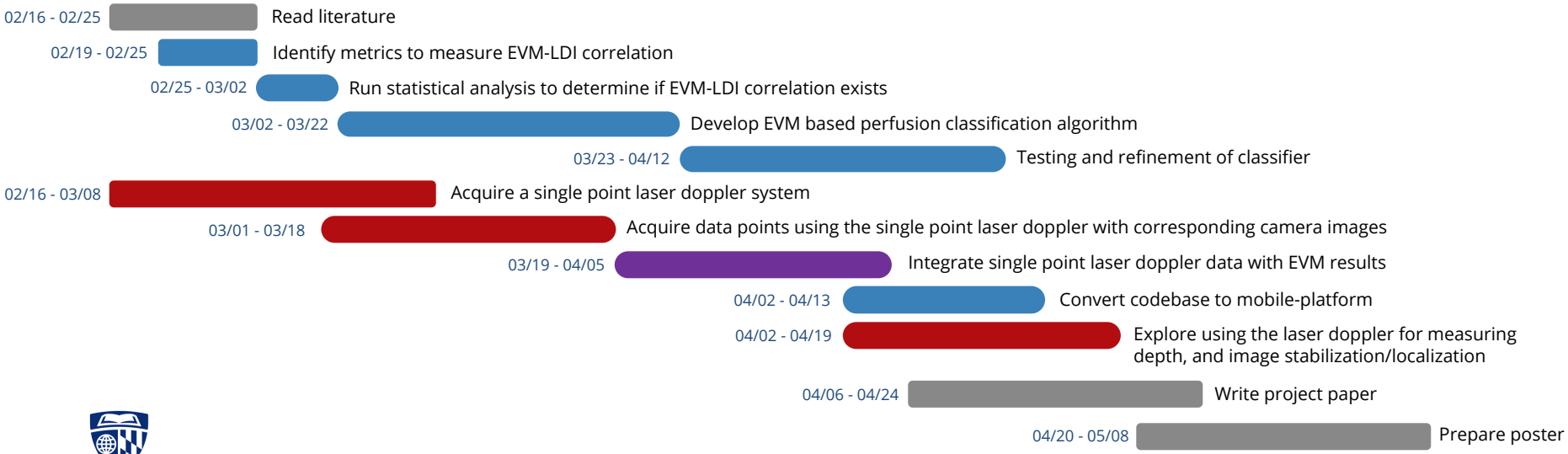
Dependencies

Budget of approximately $5,000 from Tissue Analytics.

- Camera and laser doppler images of human tissue
  - Already acquired enough to start with, Tissue Analytics will provide more by 2/27 at the latest
- Compact laser doppler system
  - Market availability confirmed, price estimated between $500-1000
  - Training will be arranged by Tissue Analytics

Timeline





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Deliverables

- Minimum
  - Proof (or disproof)-of-concept of EVM as a method of perfusion assessment.
- Expected
  - Classification algorithm that applies EVM to smartphone collected images and categorizes perfusion into at least 3 bins.
  - If EVM alone is insufficient: EVM integrated compact single point laser doppler system for assessing perfusion.
- Maximum
  - Full integration of algorithm (with or without additional hardware) with existing smartphone application.
  - Use of LDI technology for image stabilization/localization and depth measurement.

Management Plan

- Github: source code version control
- Podio: task allocation and management
- Biweekly meetings with Dr. Boctor and Tissue Analytics contact (Josh)

Rohit

- Python scripting
- Literature review
- Machine learning
- Statistical analysis
- Paper/poster writing

Yvonne

- MATLAB coding
- Code management
- Communications
- Dependency resolution
- Data acquisition

Azwad

- Python scripting
- Literature review
- Image processing/analysis
- Machine learning
- Instrumentation

Literature

1. Wu, H., et al. ”Eulerian Video Magnification for Revealing Subtle Changes in the World”. ACM Transactions on Graphics (TOG)- Proceedings of ACM SigGraph 2012. 31.4 (2012). July 2012.
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6. Russell, S. and Norvig, “Chapter 18: Learning from Example”. *Artificial Intelligence : A Modern Approach*, Englewood Cliffs, NJ: Prentice-Hall, 2009.

Questions/Comments?