Centre for Nanoscale BioPhotonics
ARC CENTRE OF EXCELLENCE

Stronger, faster, better:
Measuring your physiology for optimal performance

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Microvessels are important

- Microvessels
  - < 200μm diameter
  - Critical for healthy tissue nutrition and function
- Heat regulation
  - Increased blood flow near the skin surface to lose heat
  - Exercise can change microvessels to improve our heat regulation
- Disease
  - Diabetes
    - Kidney disease (nephropathy)
    - Nerve damage (neuropathy)
    - Eye damage (retinopathy)
  - Cardiovascular disease
  - Microvessels can provide non-invasive indicator of systemic disease

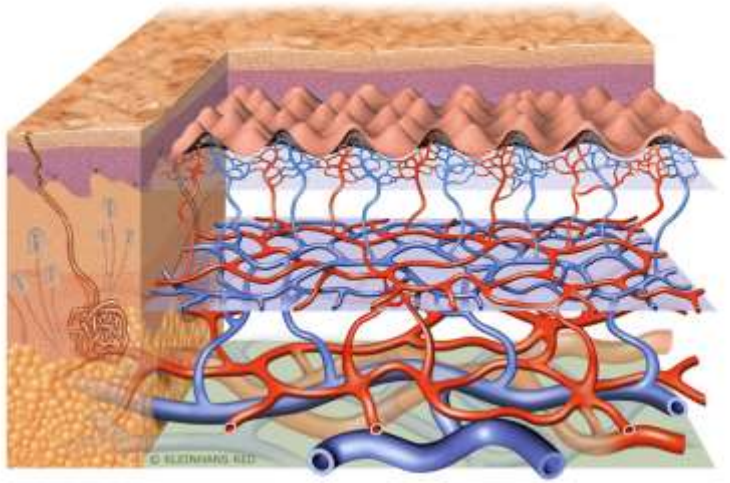

Image courtesy of Skin Care Forum, BASF Personal Care and Nutrition GmbH.
www.skin-care-forum.basf.com

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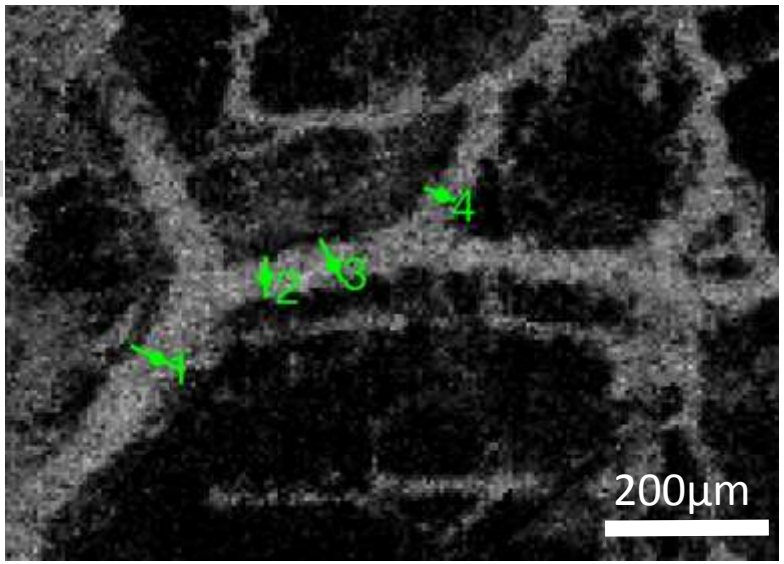
Overview of research

- Our research
  - Non-invasive assessment of microvessels
  - Optical imaging
  - Have developed automated quantification algorithms
  - We can measure blood flow speed and volume
  - Measure to depth of approx. 1mm

Point	Diameter (microns)	Speed (microns/sec)	Flow (picolitres/sec)
1	67	118	417
2	50	137	269
3	56	119	291
4	38	111	126



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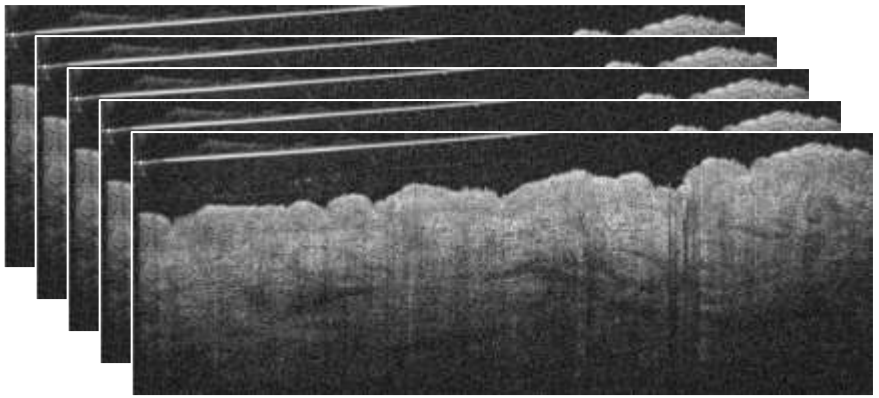
Optical imaging

- Optical coherence tomography
  - Non-invasive optical imaging technology
  - Analogous to ultrasound, but uses light waves instead of sound
  - Scanner available as off-the shelf component from multiple manufacturers
  - Builds up high resolution 3D volume of tissue
  - Resolution approx. 10-20 microns



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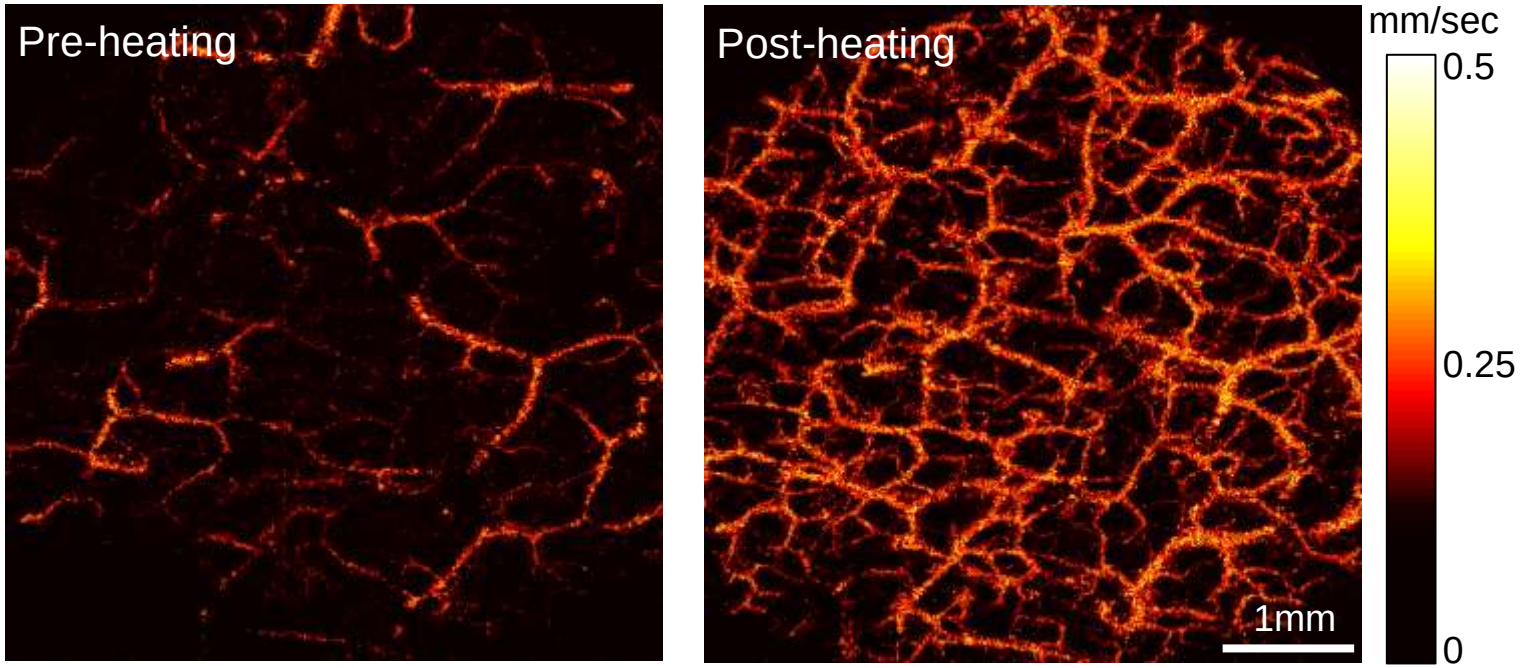
Human experiments

- 8 human subjects
  - 5mm x 5mm field-of-view
  - Quantified change in blood flow in response to heating
  - Collaboration with Prof. Danny Green, University of Western Australia
  - We are able to quantify these changes



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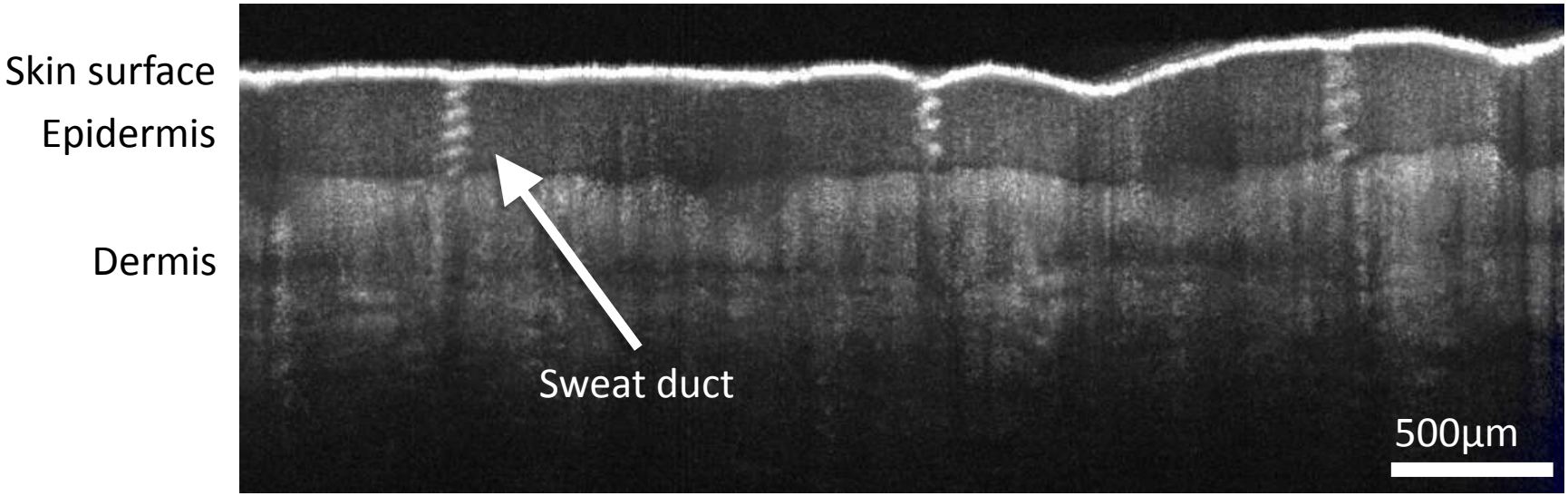
Sweat ducts

- Optical imaging to gain a broader understanding of heat regulation
- Sweat duct imaging
  - OCT image shows cross-sectional view of a human palm
  - Sweat ducts appear as small coils through the epidermis



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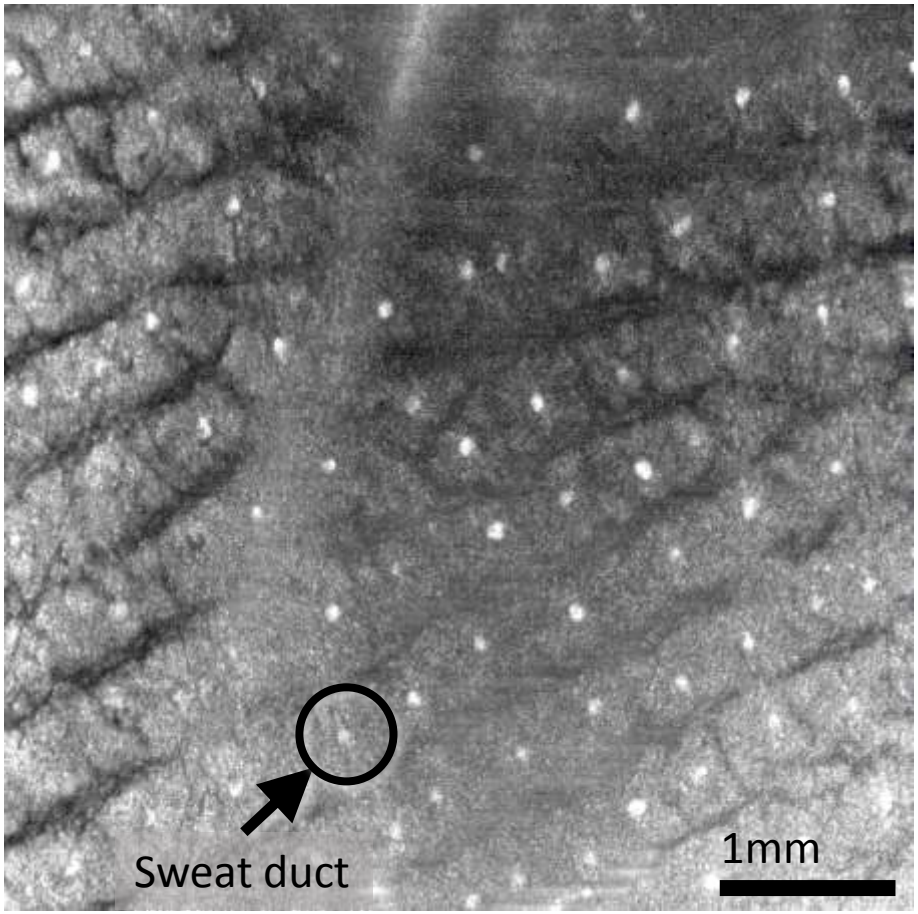
Sweat ducts

- Sweat duct imaging
  - OCT image taken parallel to skin surface, through epidermis
  - Sweat ducts visible as small white dots
  - 5mm x 5mm field of view



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Trends and drivers

- Societal & Technical trends and drivers
  - Optical imaging allows non-invasive imaging of physiology
  - Imaging is only half the story…
  - Automated quantification algorithms provide data to drive decisions
  - More data allows better decisions
  - It is critical to make data gathering cheap, robust and easy

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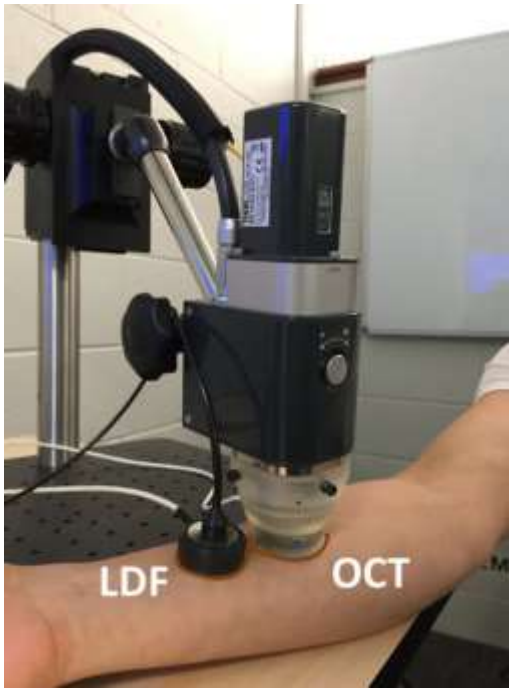
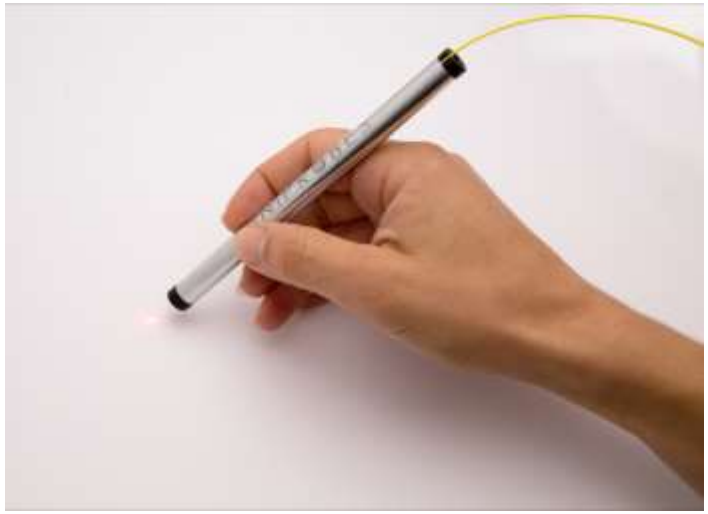
Inexpensive optical probes

- Example: Miniprobes
  - Provide functionality of $10,000 scanhead for $495





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Miniprobes

Future trends

- 10-20 years
  - 24/7 monitoring of my physiology
  - My phone monitors where I go
  - My fitbit monitors how much effort I exert
  - My GPS monitors traffic
  - **When will I get probes that monitor my health?**
- Gaps in knowledge
  - How do we seamlessly integrate 24/7 monitoring
  - How do we gather and process the data
  - Assessment of microvessels is a useful test cast