

Lumidigm, Inc.



Agenda

- Introduction to Lumidigm
- Spectral biometric technology
- Development program



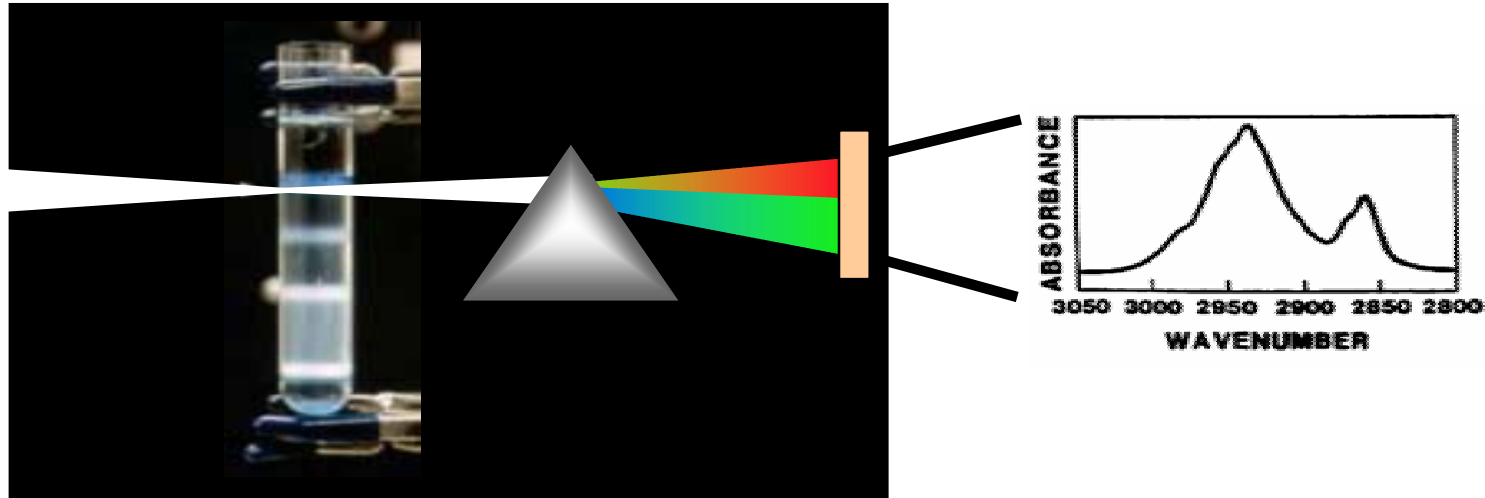
Introduction to Lumidigm

- Biometrics company spun off from InLight Solutions (formerly Rio Grande Medical Technologies) on July 1, 2001
- Serendipitous discovery of spectral biometric technology from InLight medical diagnostic technology platform
 - Pre-spin in-house biometric development funded by InLight
- Strategic partnerships:
 - Smith & Wesson with NIJ support, Visteon, Ingersoll-Rand (RSI)
- Investors:
 - Wasatch Venture Fund, DFJ/New England, International Venture Fund, IDEO



Spectroscopy

The Science Underlying Spectral Biometrics



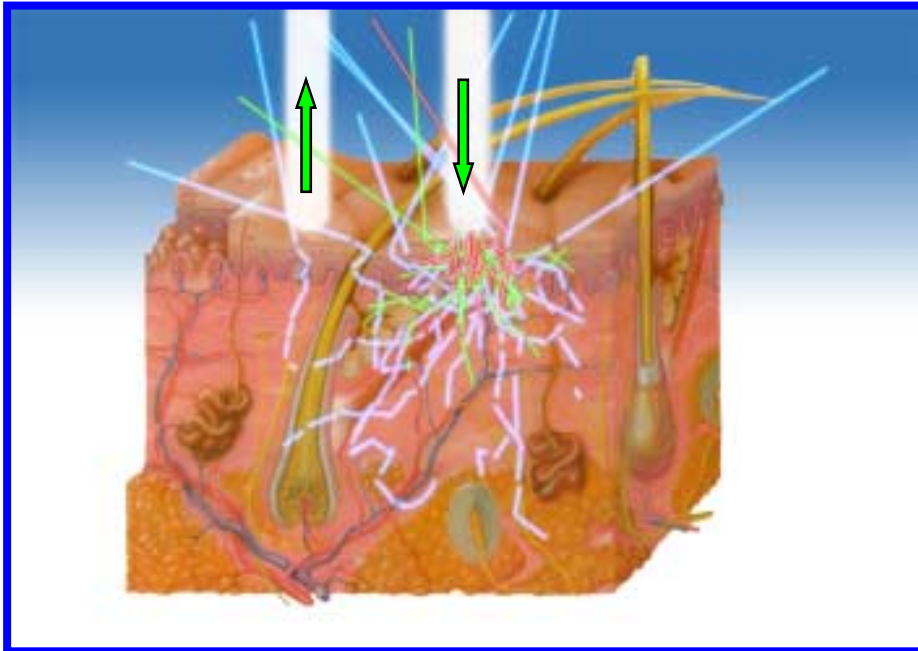
- Pass multiple colors (“wavelengths”) of light through a sample
- Measure light at each wavelength (“spectrum”)
- Analyze spectrum to infer physical properties of the sample
- We refer to the use of spectroscopy for biometrics as LightPrint™



Lumidigm Approach

LightPrint™

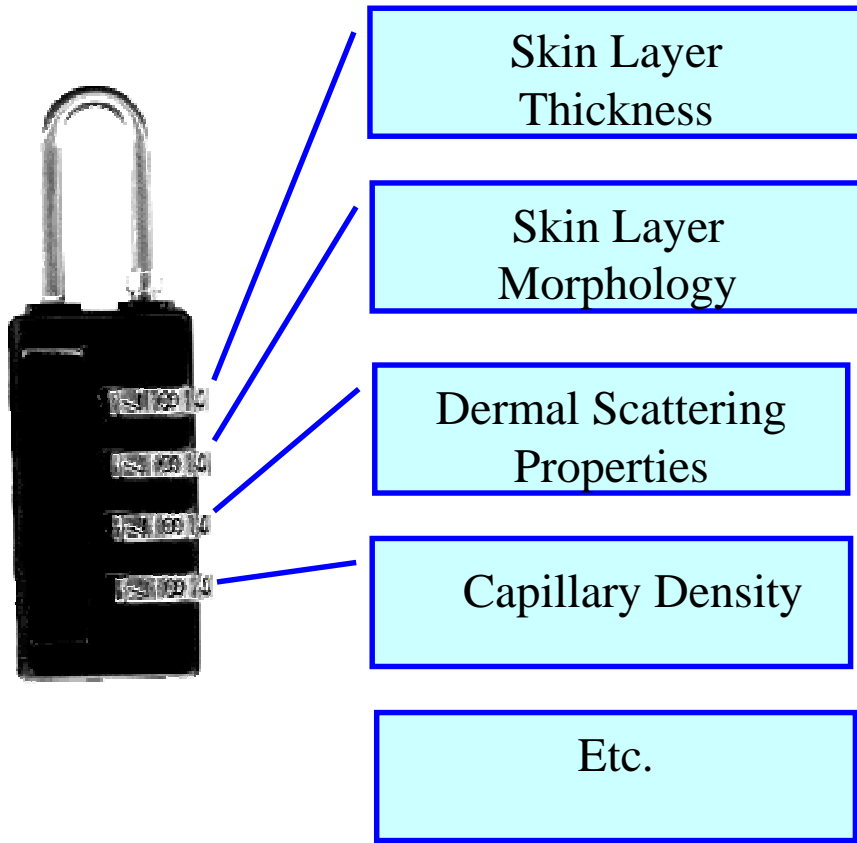
Optical deep-tissue characterization



- Diffusely reflected light shows the effect of:
 - Thickness of skin layers
 - Morphology of skin interfaces
 - Scattering properties due to collagen mix, density, orientation
 - Capillary density
 - Etc.
- ... and each of these vary by individual



LightPrint™ Analogy



Many of the parameters of the skin and underlying tissue that vary person to person have unique “spectral signatures” or “factors”

Each of the parameters with a spectral signature can be thought of as a tumbler in a combination lock

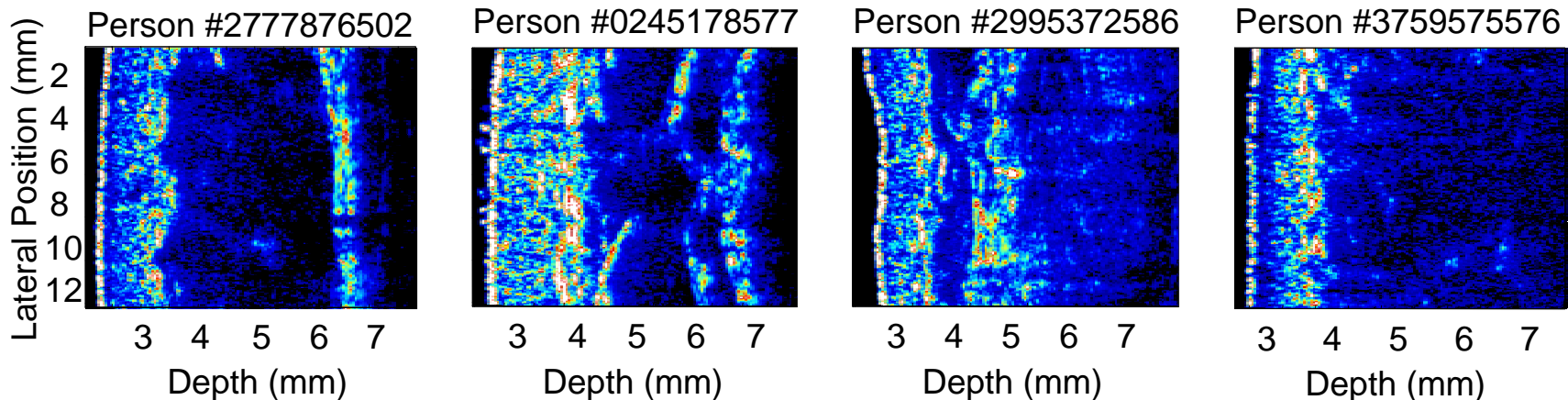
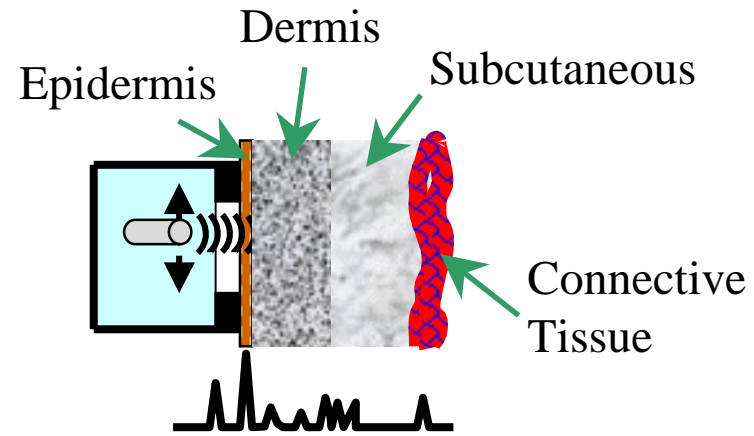
We typically use 13 factors for our biometric analysis

→ Configuration dependent



Person-Person Differences in Skin High-Frequency Ultrasound Images

- Many of the structures imaged by ultrasound also represent optical absorbers/scatterers that affect a spectral measurement



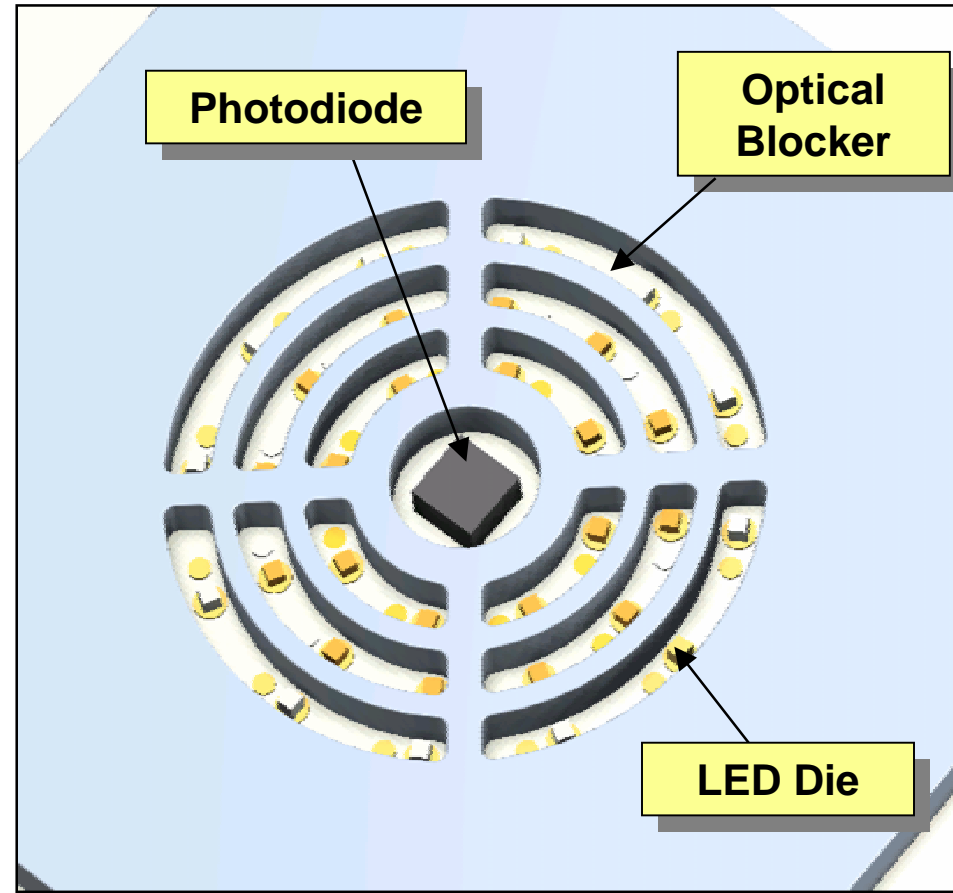
LightPrint™ Sensor Prototype Configuration

■ Components

- ❑ 32 visible/near infrared light emitting diodes
- ❑ 1 silicon PIN photodiode
- ❑ Al₂O₃ ceramic substrate and blocker
- ❑ Optical encapsulant

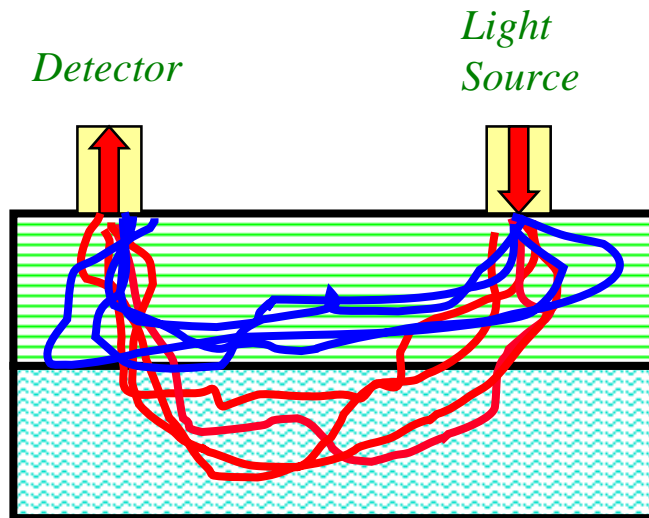
■ Size

- ❑ 44-Pin leadless package
- ❑ 0.6" x 0.6" x 0.050"
- ❑ 0.25" diameter optically active region

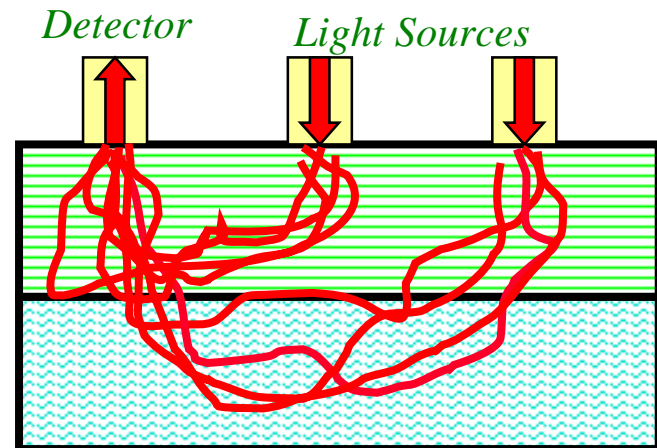


Two Critical Device Design Parameters: Wavelengths and Sensor Geometry

- Different wavelengths provide different information about skin
 - Absorbance differences
 - Scattering differences

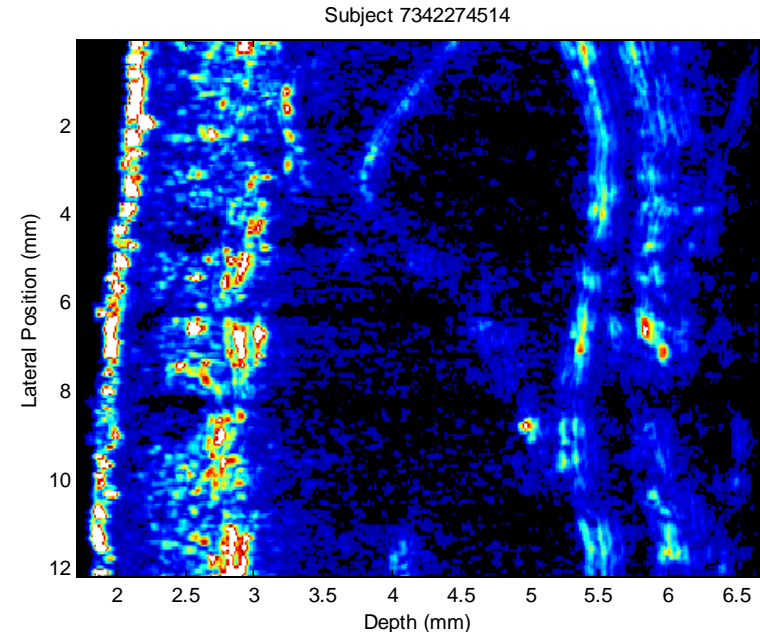


- Different source-detector separations provide different information about skin
 - Path length
 - Penetration depth



LightPrint™ Spoofing Requirements

- To match the spectral signal of skin as seen by a LightPrint™ sensor requires:
 - Same spectral absorbers...
 - ◆ Especially hemoglobin, lipid, water, melanin
 - ... embedded in a similar optical scattering matrix
 - ... with the same optical pathlengths and penetration depths for each source-detector pair



Hard To Do



Lumidigm LightPrint™ Sensor



Key differentiators of LightPrint™:

- Small sensor (*inexpensive, easy to integrate*)
- Simple algorithm, small memory requirements (*fast results using cheap, low-power processor and electronics*)
- Works on many skin surfaces (*sensor placed so it is convenient for normal use*)
- Liveness assurance using a hidden biometric signal (*difficult to spoof*)
- No known populations unable to use (*applicable to entire customer base*)
- Complementary biometric signal (*suited to layered biometric systems, e.g. hand geometry or fingerprint*)



LightPrint™ Applications



*Single biometric,
Application specific*

*Single biometric,
General purpose*



*Dual biometric,
Performance &
Liveness*



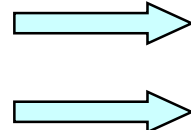
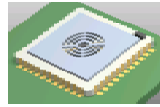
Broad applicability of the small, low-power, inexpensive sensor



LightPrint™

Product Development Roadmap

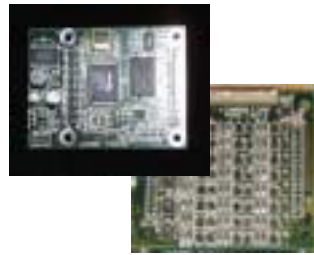
Sensor



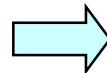
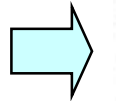
Reshaped
Reduced Components

Multi-chip
Module

Electronics



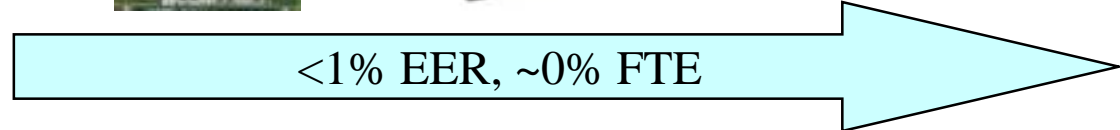
Miniaturized



ASIC

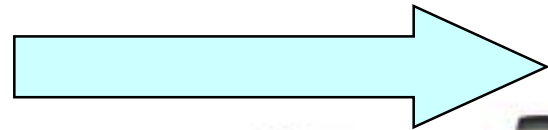
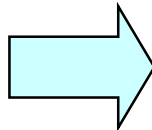


Performance



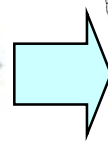
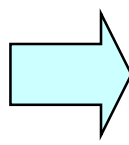
Power

Requirements



Product

Compatibility



& Developer Kit

& Liveness



Ultra-Miniature
Applications



Final Thoughts

- Spectral methods provide a new and complementary way to perform biometric determinations
- The team at Lumidigm is actively pursuing the development of practical implementations of spectral biometrics
- Please contact me for any additional follow-up thoughts or questions

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