

Development of Portable Raman Spectroscopy as a Clinical Tool for Assessing Photodamage in Skin

Ira Mautner^{1,3}, Michel Nieuwoudt^{2,3,4}, M. Cather Simpson^{1,2,3,4}, Paul Jarrett^{5,6}

Just Imagine... you walk into your local pharmacy or doctor's office, and they pull out a small device with a light pen attached. They touch the pen against your forearm for 20 seconds, and then inform you that you are in the 80th percentile of lifetime UV skin damage for someone your age. **Would this affect the way that you protect your skin from that point on?** We believe it would, and that this simple motivation for a change in behaviour could save you from premature aging of the skin due to sun damage and skin cancer such as melanoma.

The project so far

Raman spectra from both sun-exposed and sun-protected skin regions were measured in 119 participants aged four to ninety-four years old using a portable Raman system. PCA (principal component analysis) and PLS (partial least squares) regression was performed on the data to identify spectral regions which correlate with age.

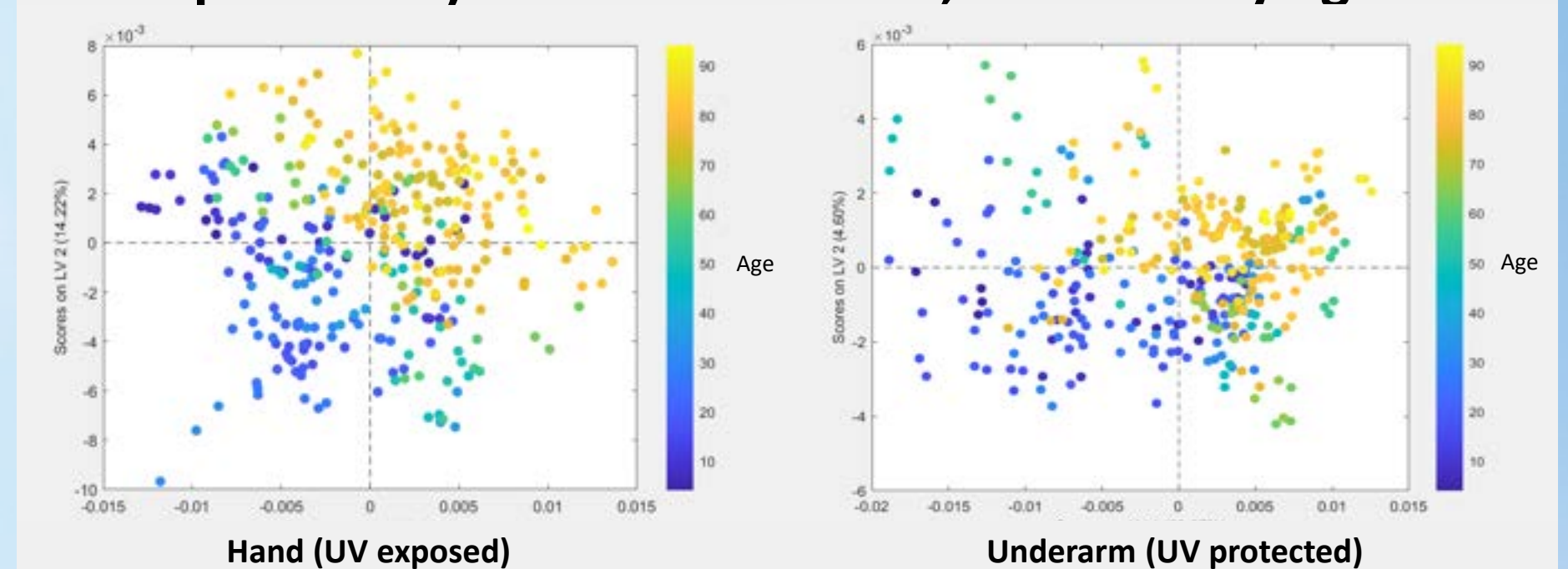
Objective

Our objective is to find spectral regions, resolvable with the portable Raman system, that correlate with age for UV exposed skin *but do not* correlate with age for UV protected skin. These spectral regions will be indicative of biochemical changes associated with UV damage in skin.

Results

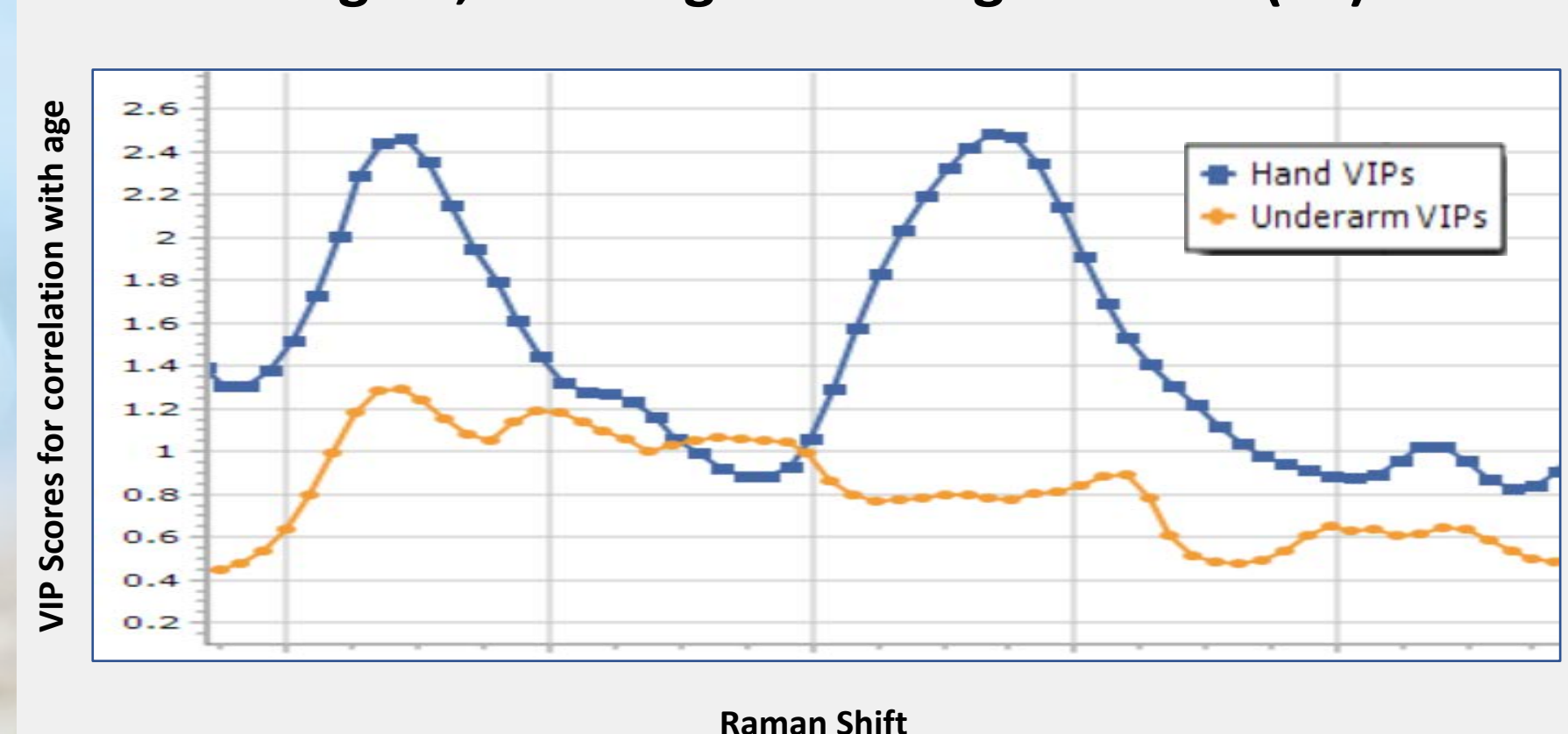
These plots of a PLS analysis demonstrate that combinations of Raman shift wavenumbers called latent variables (LVs) can be constructed that separate samples by age, for both UV exposed and UV protected skin regions.

PLS Scores of Hand (UV exposed) and Underarm (UV protected) Raman intensities, coloured by age



Variable Importance in Projection (VIP) scores indicate the importance of spectral regions to the correlation with age. Below we can see two regions that correlate strongly to age *in only the UV exposed skin*. These are the potential biomarkers that we are looking for.

VIP Scores of Hand and Underarm over one spectral region, showing VIPs of significance (>1)



Next steps – are to identify the underlying biochemical changes and confirm these using mass spectroscopy, and perform confocal Raman mapping on skin biopsies to identify the strata where these changes are occurring.

¹ The Photon Factory, Department of Physics, University of Auckland, Auckland, New Zealand

² The Photon Factory, School of Chemical Sciences, University of Auckland, Auckland, New Zealand

³ The MacDiarmid Institute for Advanced Materials and Nanotechnology, New Zealand

⁴ The Dodd-Walls Centre for Photonic and Quantum Technologies, New Zealand

⁵ Department of Dermatology, Middlemore Hospital, Counties Manukau Health, Auckland

⁶ Department of Medicine, The University of Auckland, Auckland, New Zealand