

# Measurement of Chemical Penetration and Distribution in Skin using Raman Imaging and Chemometrics

Anukrati Goel

PhD - Dept. of Chemical & Process Engineering,  
University of Surrey





# Introduction

## Topical delivery to skin

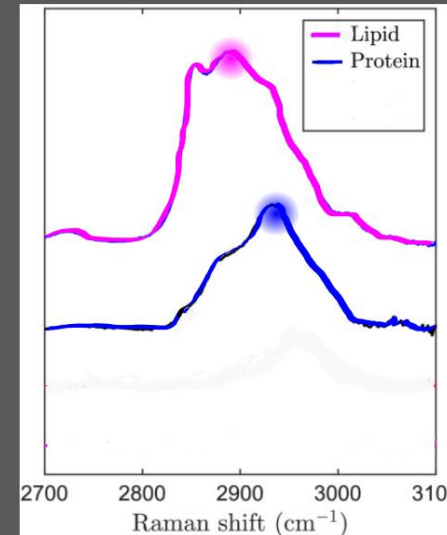
- Dermatological – local delivery
- Pharmaceutical – systemic delivery

## Requirements:

- Understanding of penetration pathways
- Knowledge of transport kinetics in skin tissue

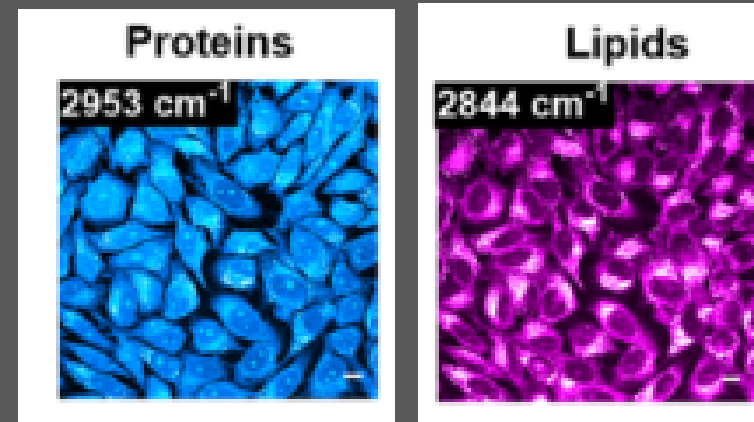
## Methodology:

- Stimulated Raman Scattering imaging: submicron spatially resolution quantitative images



Raman spectra

Tuning the microscope to vibrational mode of interest, gives information about its distribution in the sample



SRS images at respective wavenumbers

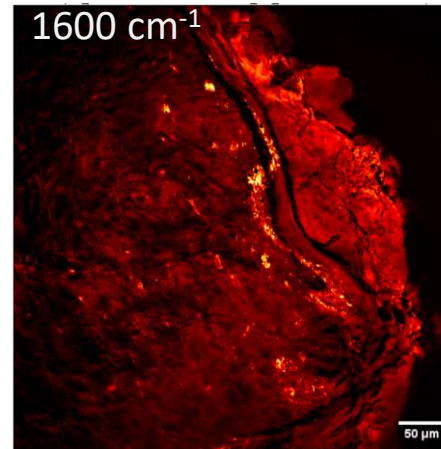
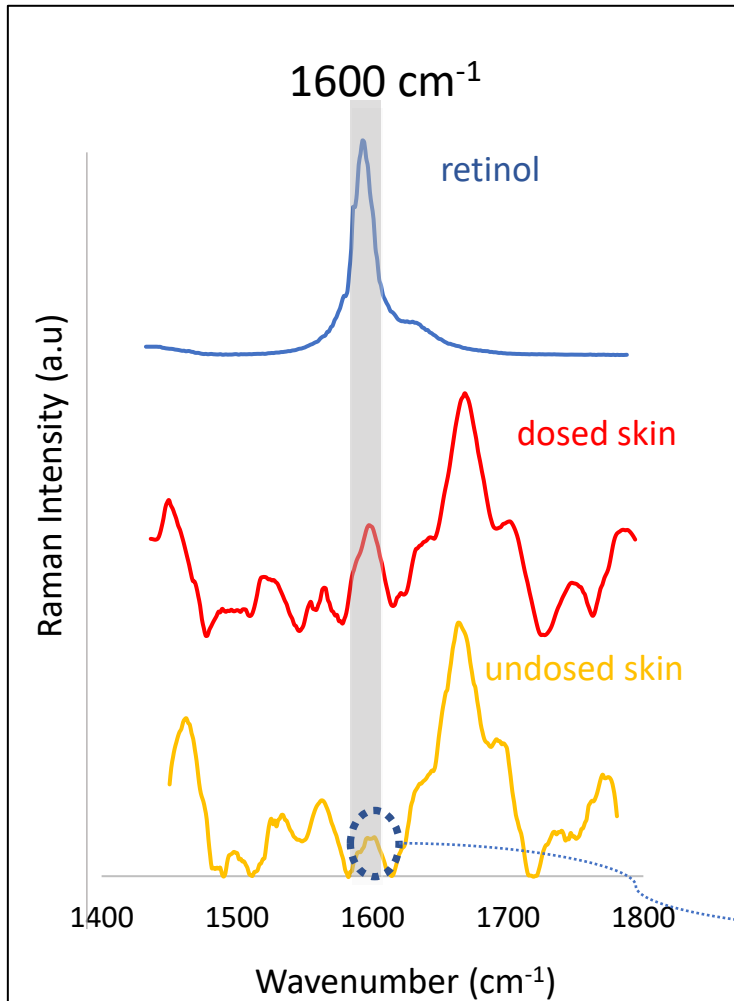


# Challenge

Study: Treating the skin with retinol based formulation

Aim: To identify retinol distribution in skin layers

Methodology: SRS imaging to identify retinol distribution by targeting C=C bond at  $1600\text{cm}^{-1}$



Distribution of retinol in skin...*Is it really?*

Presence of C=C signal in native tissue

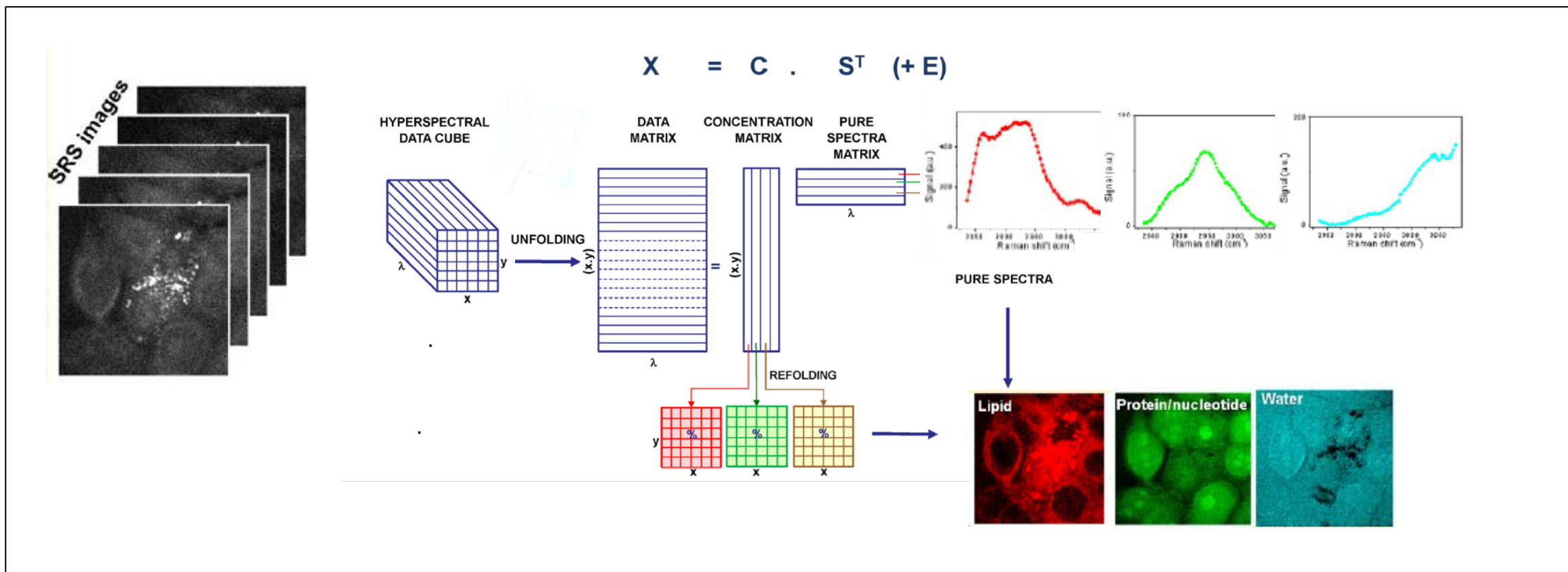
Signal contribution from retinol  
?

Signal contribution from endogenous species  
?



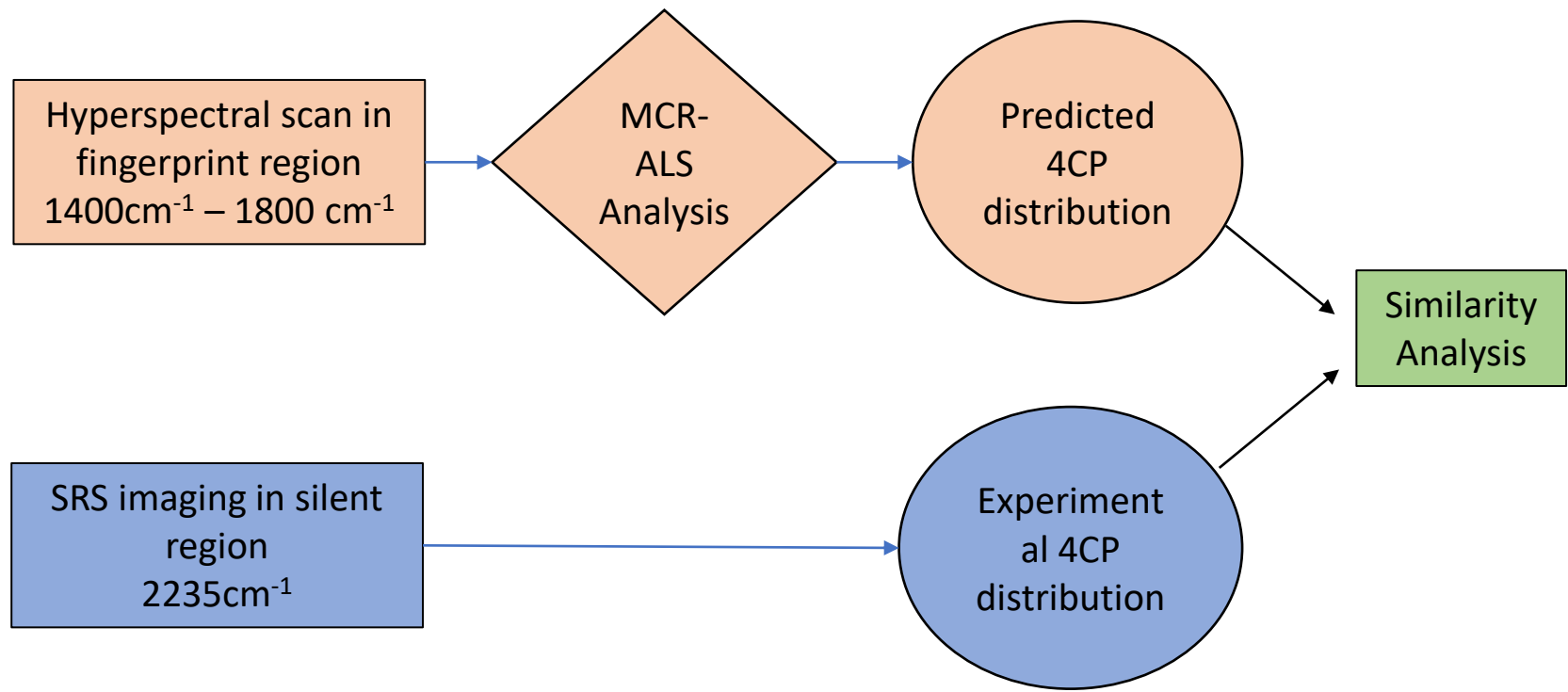
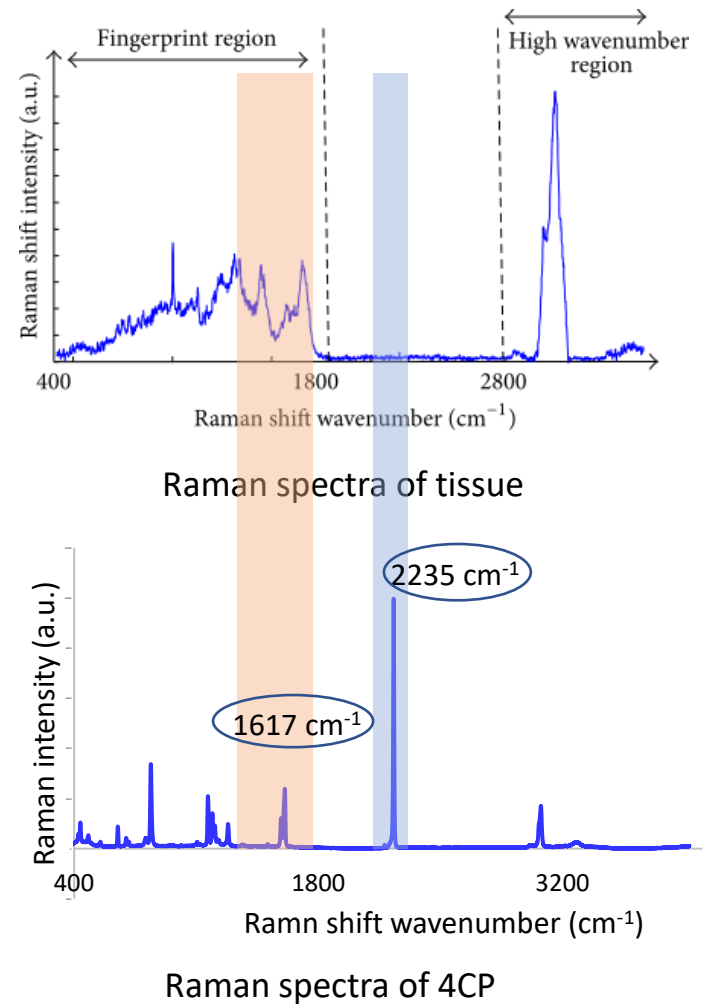
# Methodology

- Aim: Identify signal contribution from active ingredient and native tissue
- Can be achieved by combining hyperspectral imaging with multivariate analysis for spectral unmixing
- MCR-ALS: Decomposes data matrix into individual contribution



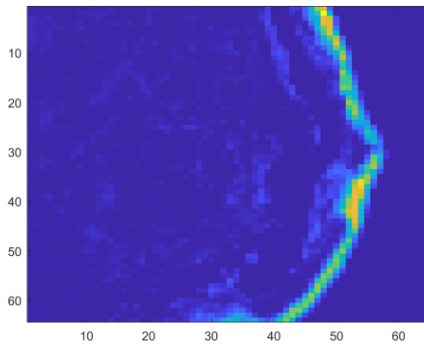
# Case Study: Spectral unmixing to predict 4-cyanophenol distribution

- Identify distribution of 4CP in skin
- **Why 4CP?** - Presence of signal in both fingerprint and silent region
- How similar are the predicted and experimental distribution?

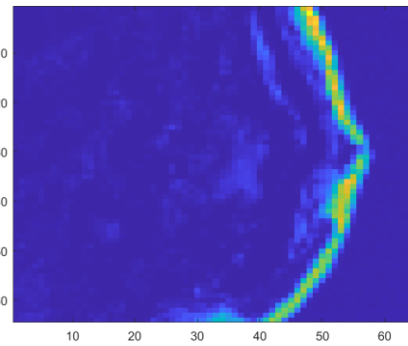


# Results & Conclusions

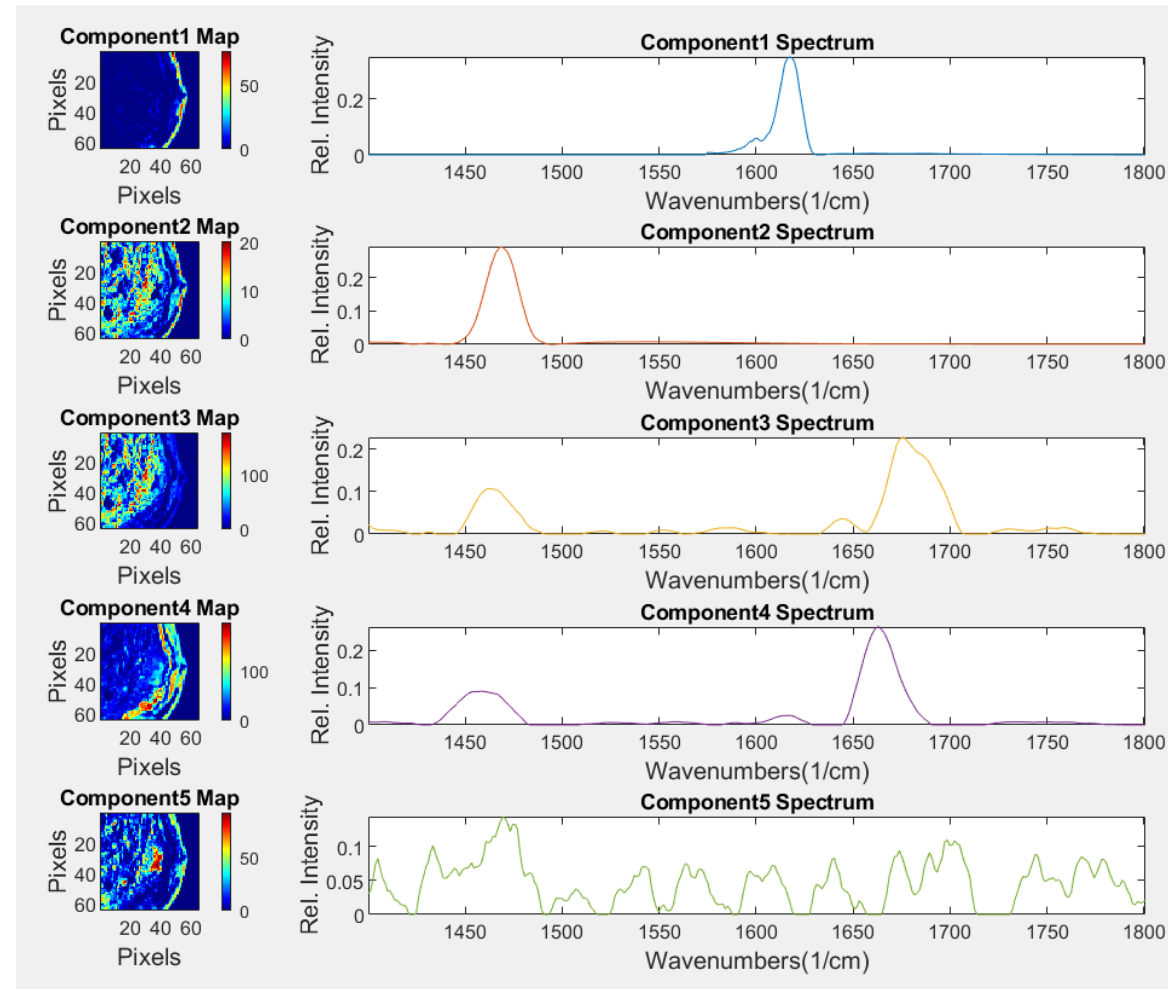
- Decomposed raw spectra into 5 components
- Identified first component to be 4CP spectra
- Found similarity between experimental and predicted distribution to be 97.1 %



Predicted 4CP  
distribution  
using MCR-ALS

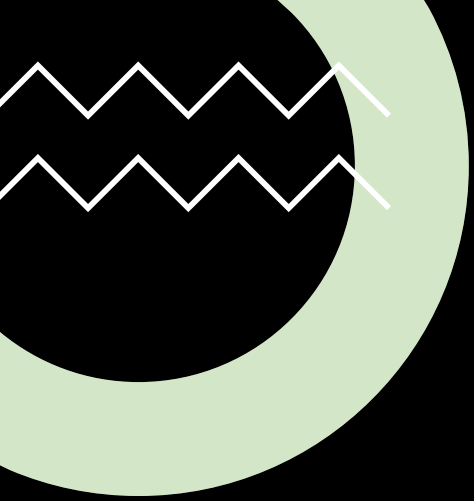


Experimental 4CP  
distribution @  
2235 cm-1



- POC to identify distribution of a chemical in skin using chemometrics
- Can be used to assess penetration in skin layers semi-quantitatively
- Novel study to track percutaneous distribution with SRS imaging





# Acknowledgement



Dr. Tao Chen  
UoS



Dr. Natalie Belsey  
NPL, UoS

## Thank You

[Anukrati.goel@surrey.ac.uk](mailto:Anukrati.goel@surrey.ac.uk)

