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Optical Detection of Bilirubin

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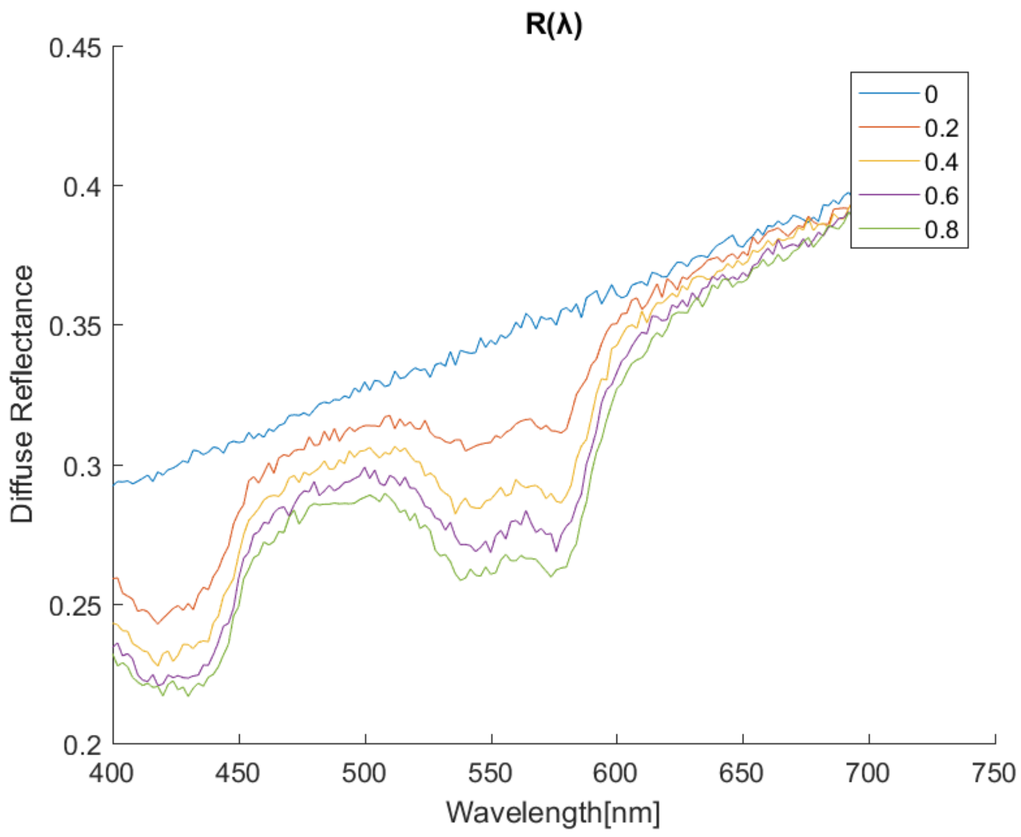
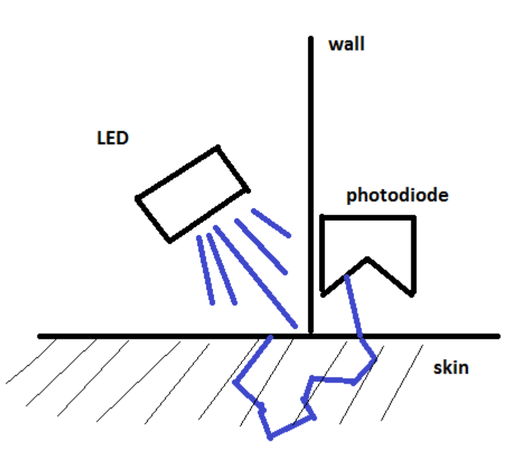
Introduction

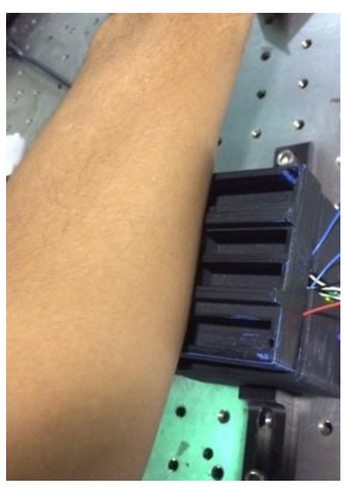
Bilirubin is a breakdown product of blood cells and a high concentration indicates liver failure or other significant medical conditions. Using Monte Carlo simulation methods and experimental data, the total diffuse reflectance of skin is found to be an indicator of the concentrations of melanin, hemoglobin, and bilirubin.



Diffuse reflectance calculated using data collected as shown in the diagram below. Concentrations of oxyhemoglobin[mg/ml] are given in the text box above.

Diagram





How diffuse reflectance is measured.

Relevance

An affordable noninvasive real-time optical bilirubin measurement method would be a substantial improvement in the early detection of multiple internal disorders in long duration spaceflight personnel and newborns.

Method

The reflectances of three different wavelengths of LEDs are used in accurately calculating concentrations of melanin, hemoglobin, and bilirubin in skin.

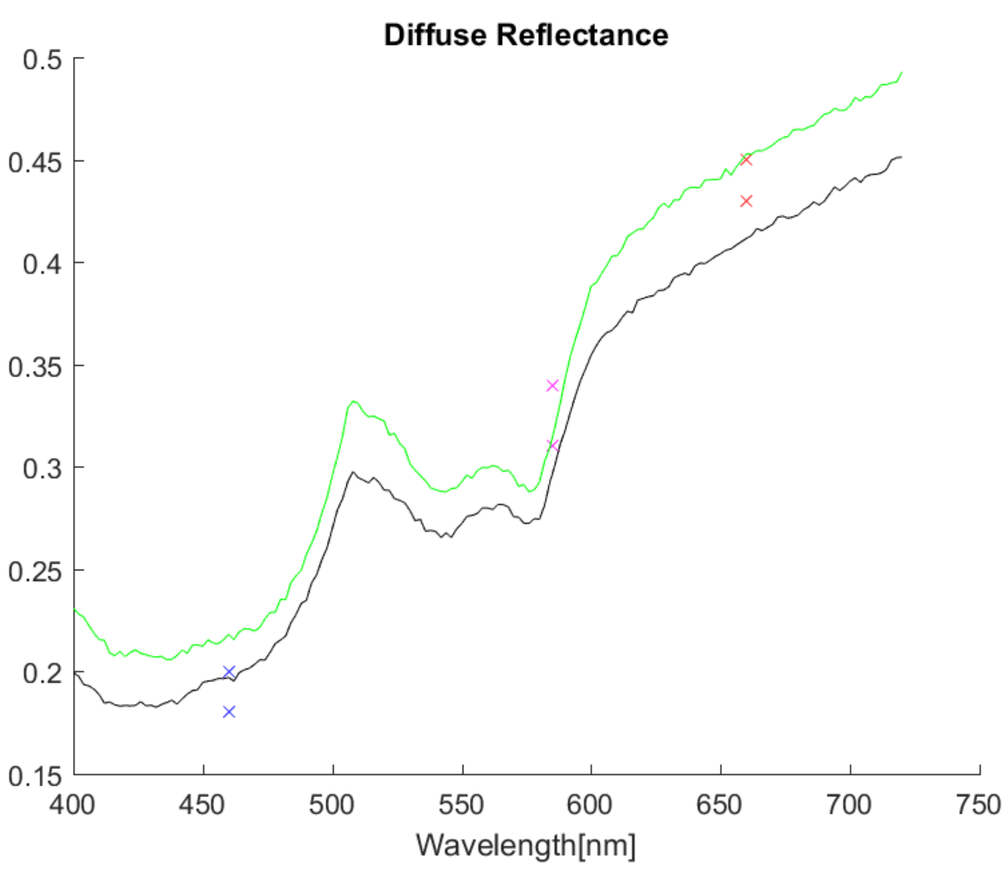
Results

Concentrations of bilirubin were determined for different parts of the body of the same person

CCD camera photo

(a)Black line below
Melanin = 0.6 [mg/ml]
Oxyhemoglobin = 0.5[mg/ml]
Bilirubin = 0.07[mg/ml]

(b)Green line below
Melanin = 0.3 [mg/ml]
Oxyhemoglobin = 0.7[mg/ml]
Bilirubin = 0.11[mg/ml]



Impact

By substituting inexpensive LEDs and photodiodes for lasers, fiber optics, and spectrometers, optical bilirubin colorimetric assay kits can be compact and affordable. Neonates could easily be checked for conditions such as jaundice at home.

Acknowledgements

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