NEWTEC

SDU

A New Dimension of Infrared Imaging

A Long Wave Infrared Hyperspectral Imager Based on a Scanning Fabry-Pérot Interferometer

Mads Nibe Larsen[1&2], Anders Løchte Jørgensen[1], Victor Petrunin[1], Jakob Kjelstrup-Hansen[2], Bjarke Jørgensen[1]

[1] Newtec Engineering A/S, 5230 Odense M, Denmark

[2] NanoSYD, Mads Clausen Institute, University of Southern Denmark, 6400 Sønderborg, Denmark

1 Initial Spectrum

The subject emits/reflect/transmits a long-wave infrared spectrum ranging from ≈ 8 µm to ≈ 15 µm. This is an example of 125 °C black body radiation being transmitted through methanol vapor.

2 Fabry-Pérot Mirrors

The scanning Fabry-Pérot interferometer (SFPI) is formed by two dielectric mirrors. The distance between them determines the distribution of wavelengths transmitted. It is possible to control the mirror separation distance, effectively turning the SFPI into a variable bandpass filter.

3 Filtered Spectrum

The incident spectrum is multiplied by the transmission profile of the SFPI. A distinct spectrum is hereby transmitted for each discrete mirror separation.

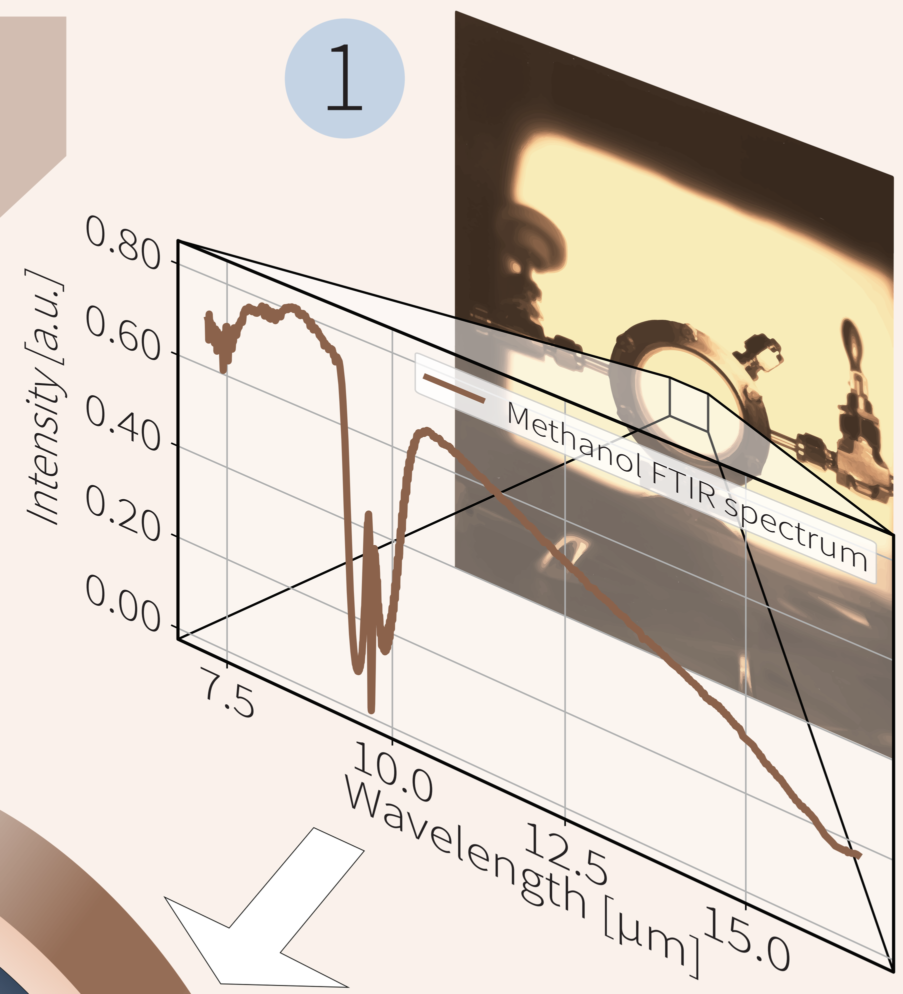
4 The Thermal Camera

A thermal camera is used to capture the incoming light. This QTechnology QT5022 camera is equipped with a Lynred Pico 1024 Gen2 1024 × 768 pixel microbolometer sensor with a set of germanium lenses used to focus the light onto the sensor.

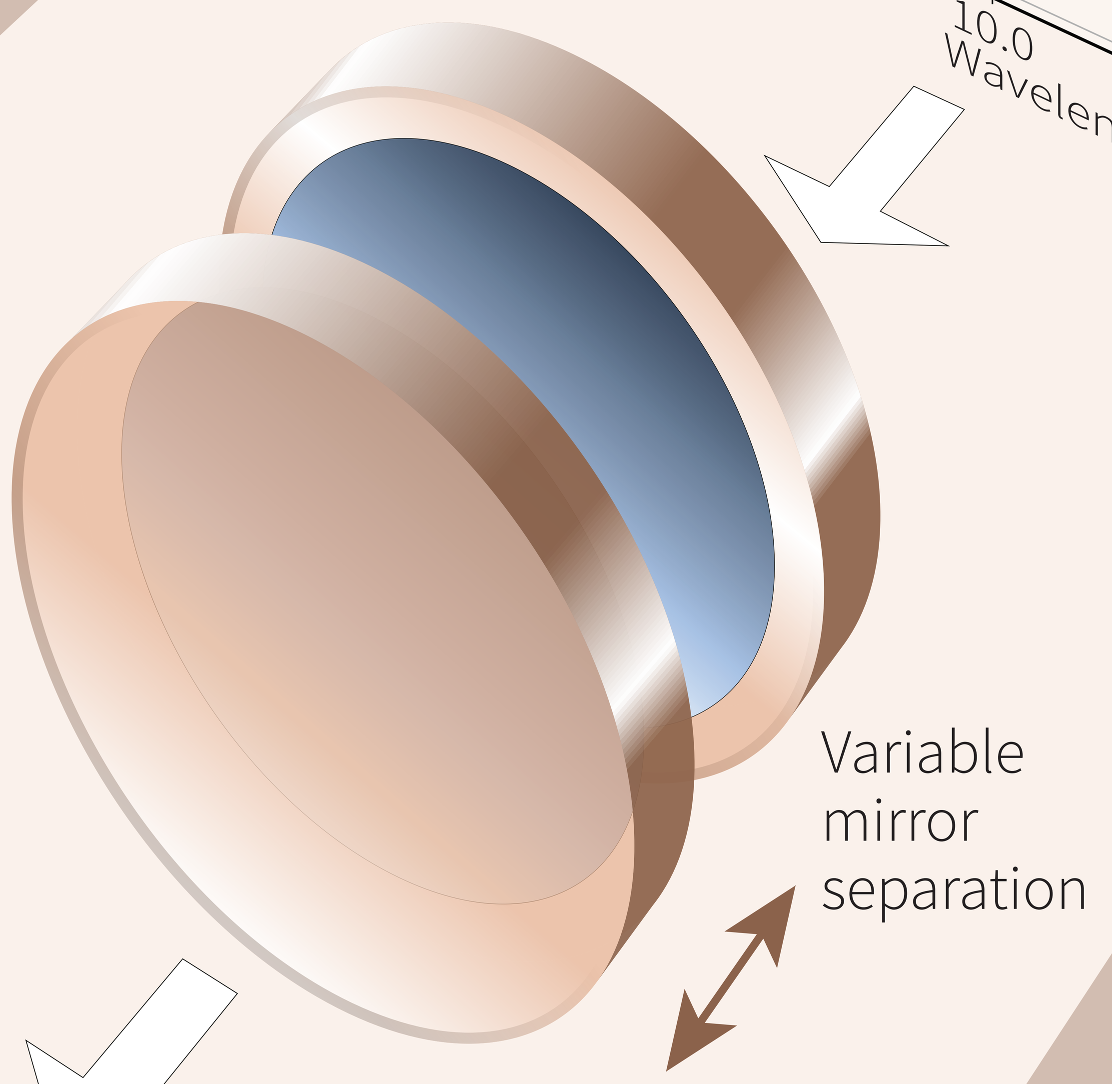
5 The Recorded Spectrum

Approximately 145 images are captured while sweeping the mirror separation distance from ≈ 3 µm to ≈ 13 µm. Each image represents the sum of the wavelength spectrum for the given mirror separation.

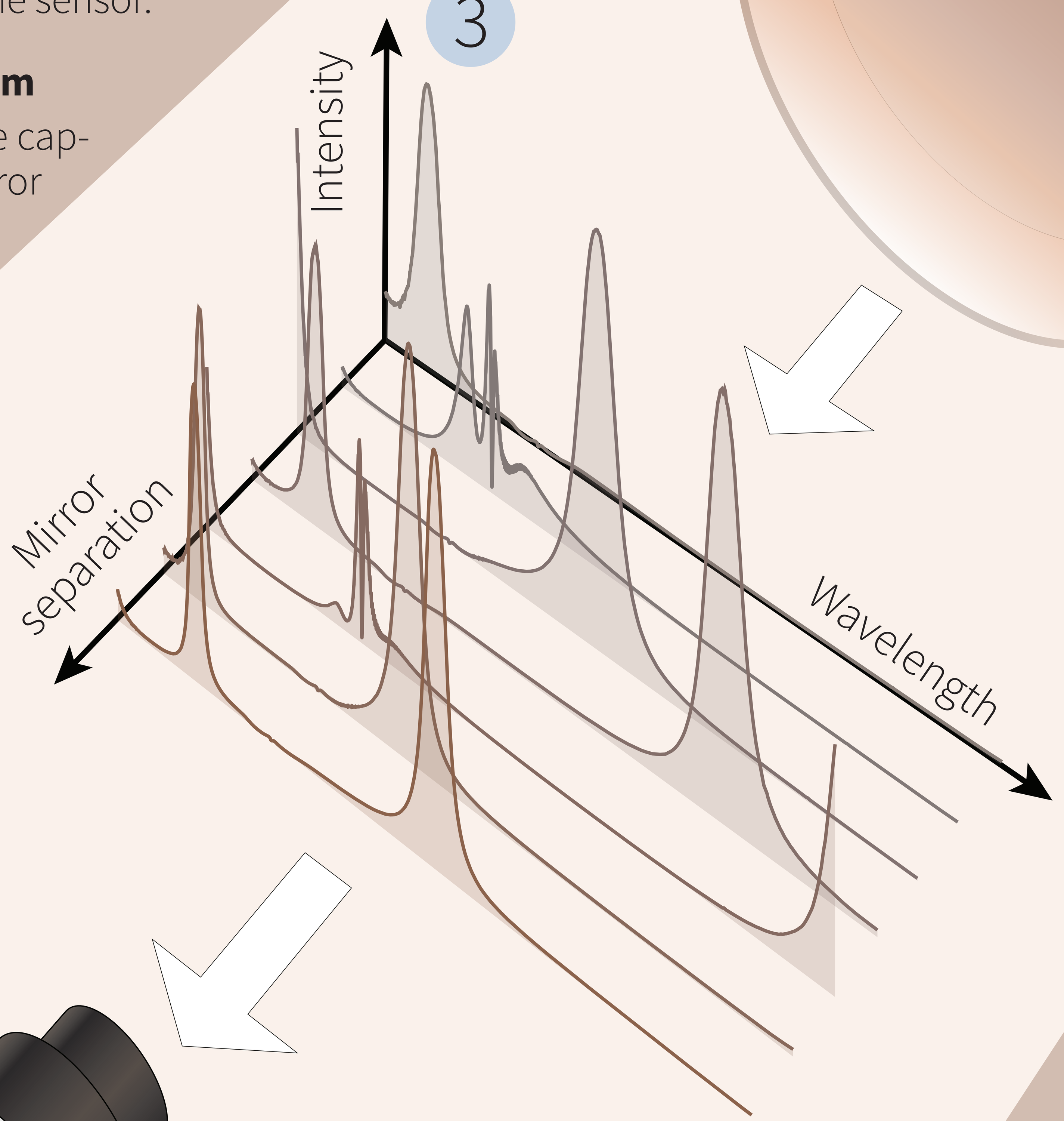
1



2



3

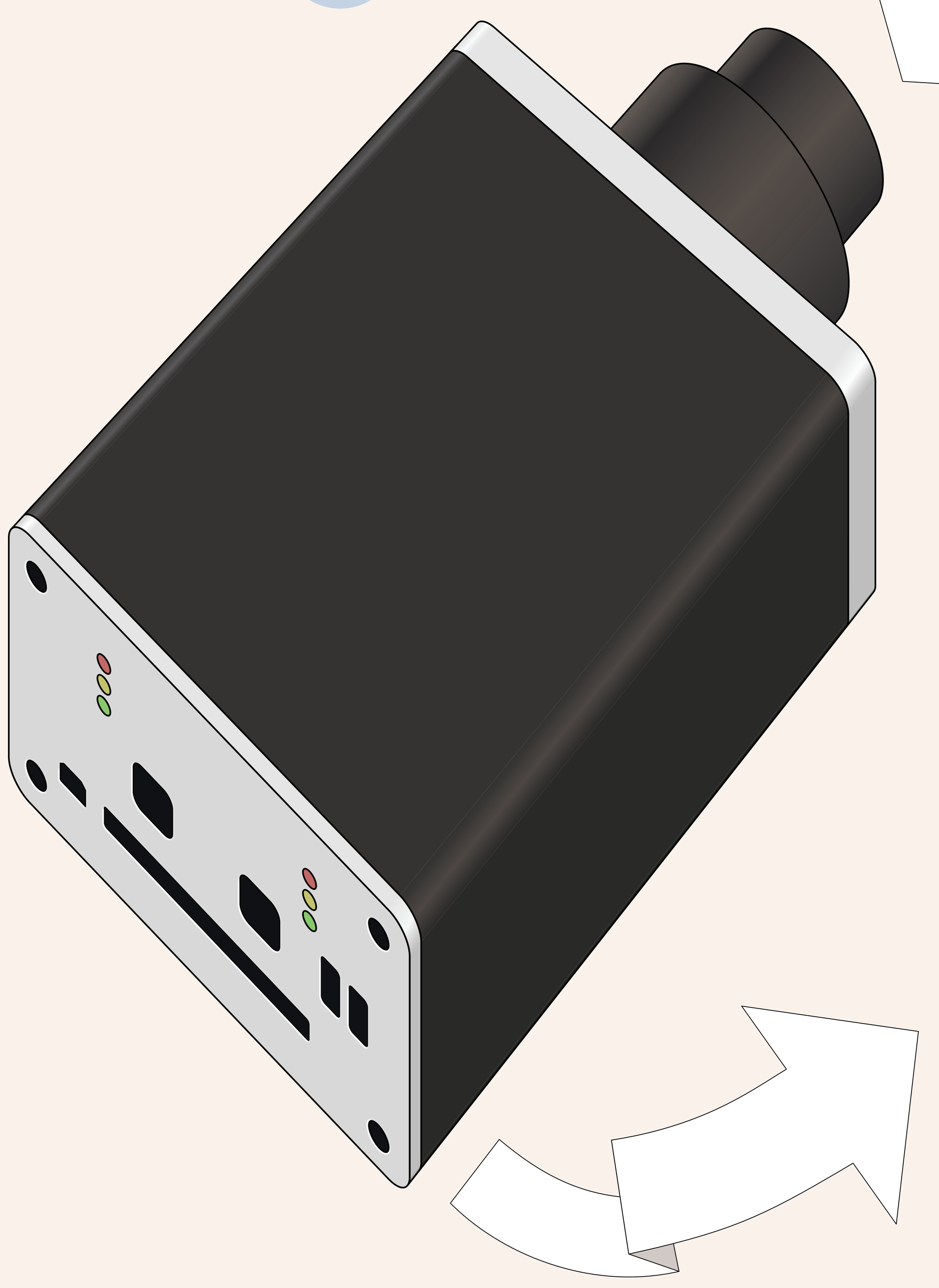


6 Estimation of Initial Spectrum

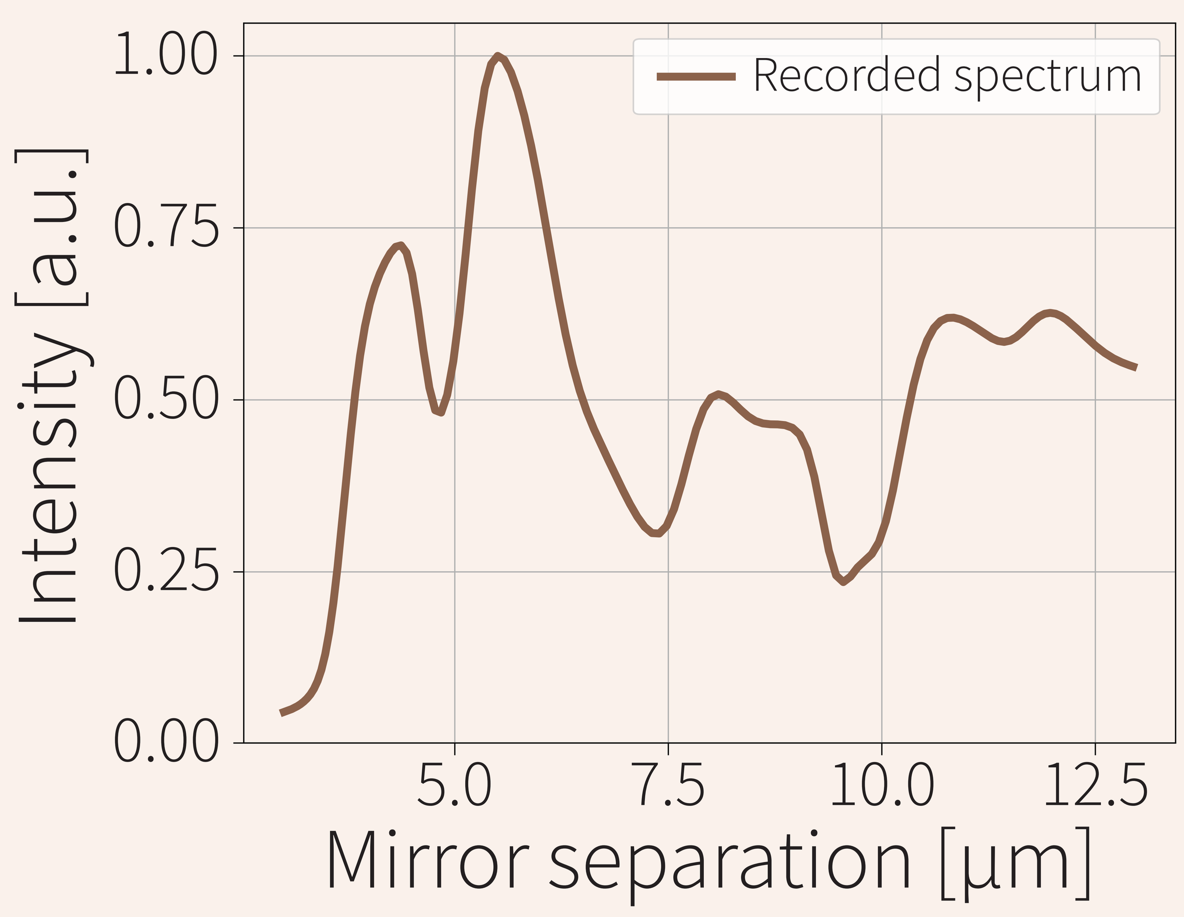
Before the recorded spectrum can be compared with conventional FTIR spectra, it must first be converted from its mirror separation dependent axis to one that is dependent on wavelength. This is a non-trivial task as each data point of the recorded signal contains information from a distribution of multiple wavelengths at once.

The transfer matrix method (TMM) can be used to obtain a theoretical relationship between the transmission profile of the SFPI and its mirror separation distance. By combining this information with the recorded spectrum, it is possible to estimate the initial spectrum using linear algebra.

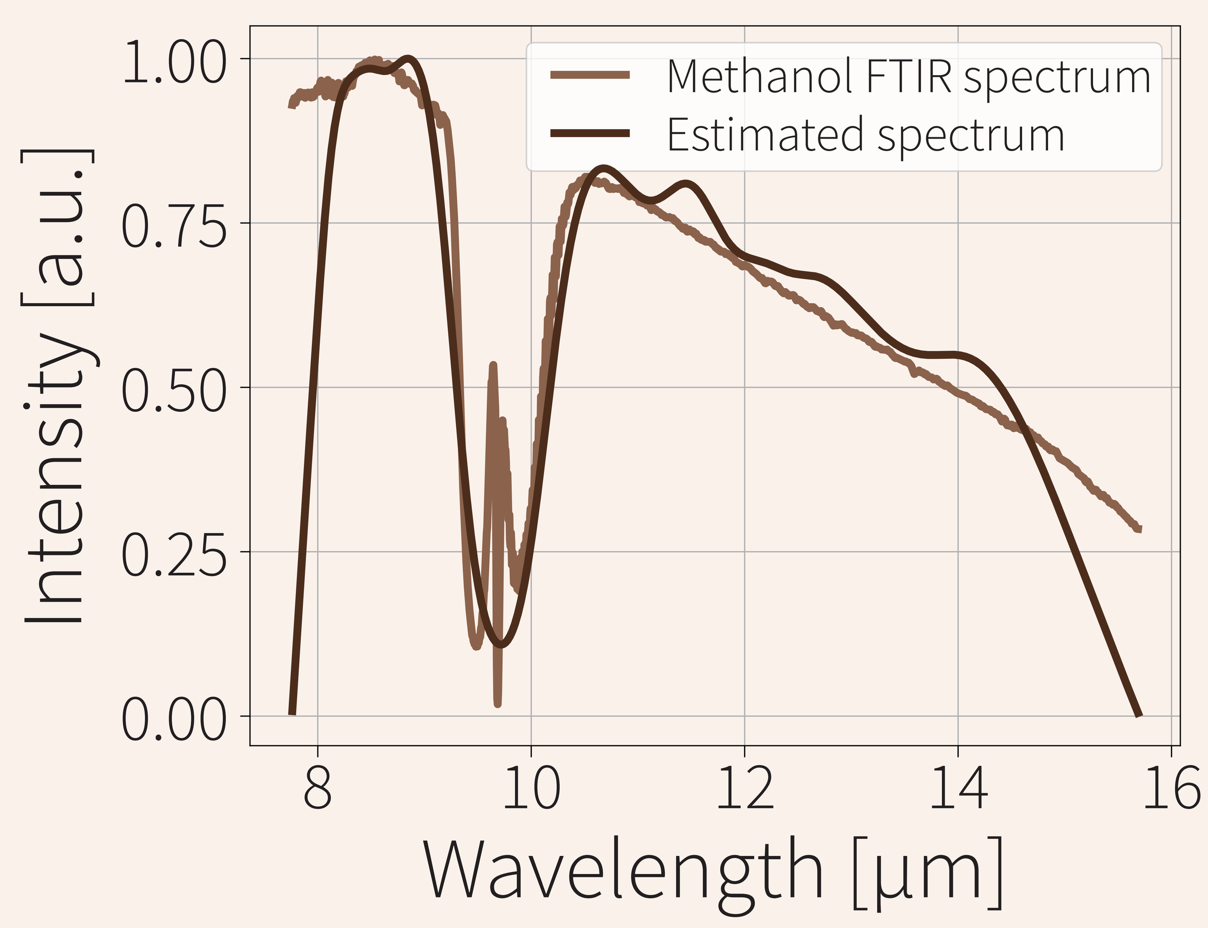
4



5



6



mani@newtec.dk

nibe@mci.sdu.dk