STSM REPORT

STSM Application number: COST-STSM-BM1205-19122

STSM Grantee: Aleksandra Zienkiewicz

STSM title: Testing of the human tissue measurement method based on the Near-Infrared Spectroscopy

Home Institution: Gdansk University of Technology

Host Institution: University of Oulu

STSM period: 16.05.2014 – 29.05.2014

STSM purpose: Development and test of the human tissue measurement method based on Near-Infrared Spectroscopy.

Description of the work carried out during the STSM:

The optoelectronic method of measuring human tissue was elaborated during previous collaboration between the laboratories, which was performed under the COST Action BM1205. The principal idea of this method is to use Near-Infrared Spectroscopy to measure changes in skin metabolism, basing on assumption that healthy skin has different sugar and oxygen consumption than cancerous skin. The project "Testing of the human tissue measurement method based on the Near-Infrared Spectroscopy" is a continuation of this work.

Near-Infrared Spectroscope which was used in all the measurement was designed and developed in the Optoelectronics and Measurement Techniques Laboratory at the University of Oulu. Basic aim of the project was to prepare the functionalities of the device which can be used in human tissue measurements and test them. The next aim is to obtain a database for further investigation. Collecting as large as possible database is currently crucial for next steps, which are skin lesions and skin cancer measurements.

First part of the project was to rebuilt and test some parts of the device, in order to improve the measurement performance. After that, the work were focused on measuring wider variety of skin samples. All the measurements were performed with different wavelengths from infra- and near-infrared area, e.g 660 nm, 830 nm, 850 nm, 905 nm. Currently the main feature that is going to be tested is blood oxygenation in examined area. All of the formulas are the same as on previous work, based on the modified Beer – Lambert law (Equation 1)

(1) $$\Delta OD = -\log\frac{I_{final}}{I_{initial}} = \varepsilon CLB,$$ where

ΔOD is the change in optical density ($\Delta OD = OD_{final} - OD_{initial}$), I_{final} and $I_{initial}$ are the intensities measured before and after a concentration change, C is the concentration of the absorbing substance, L is the distance between the light source and detector, B is a differential path length factor and ε is extinction coefficient.

Description of the main results obtained:

Small developments of the NIRS setup have been performed and the measurements on the skin with healthy lesion have been done. Obtained data are ready for further calculations, e.g blood oxygenation. Since the measurements were performed with few different wavelengths, it is possible to calculate the concentration of different substances.

On Figure 1 there is an example of the result of measurement performed on the skin with healthy nevus. There are raw data presented, measured on the nevus with size 1 cm x 1 cm and located on stomach.

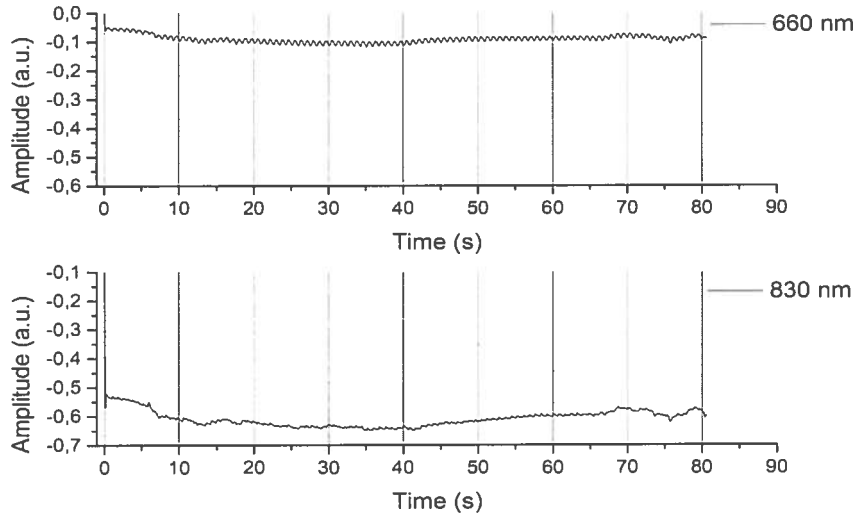

Figure 1 Healthy skin, stomach 660 nm, 830 nm.

Reference data were also collected on stomach, but outside of the nevus area (Fig. 2):

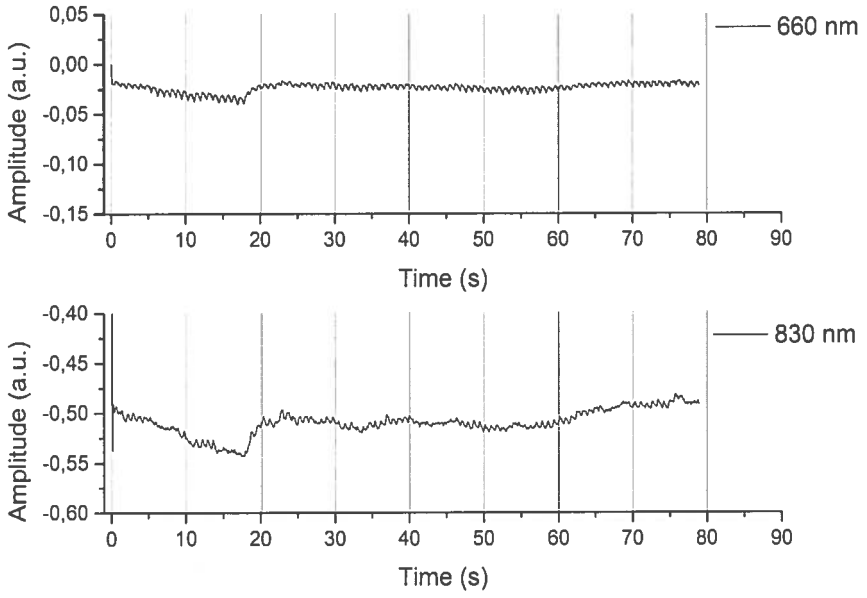

Figure 2 Nevus measurements, stomach, 660 nm, 830 nm.

Mutual benefits for the Home and Host institutions:

Working on the project under STSM was used to share knowledge and experience between researchers in the field of biophotonics. Also it gave a possibility for young researchers to work in the international environment. Further development of the presented measurement method can result in joint publications.

Future collaboration with the Host institution (if applicable):

Both institutions are interested in continuing tests related to human tissue and keep close collaboration in other projects related to biomedical technologies. Next step in utilizing NIRS device in skin cancer studies would be collecting the database of the healthy skin measurement results, which would provide significant information during statistical analysis.

Foreseen journal publications or conference presentations expected to result from the STSM (if applicable):

Preliminary draft of the publication was written, and it is planned to be published when the enough database will be gathered.

STSM outcome form

STSM application number	Home institution & country	Host institution & country	BM1205 WG	Objective of the collaboration	Results of the collaboration
COST-STSM-BM1205-19122	Gdansk University of Technology, POLAND	University of Oulu, FINLAND	WG 4	Testing of the human tissue measurement method based on the Near-Infrared Spectroscopy	Major changes in the Spectroscope, preparation for skin changes and cancer measurement.

Confirmation

Herewith I would like to confirm the completion of the STSM within the Testing of the human tissue measurement method based on the Near-Infrared Spectroscopy applied by Aleksandra Zienkiewicz.

She has worked on this project at the Laboratory of Optoelectronics and Measurement Techniques from 16st to 29th of May 2014 and fulfilled the objectives of the STSM work plan. During that time she was responsible for modifications of Near-Infrared Spectroscope and preparing the database for further studies on skin lesions

The purpose of the development was to improve and prepare the device to skin metabolism measurement.

Matti Kinnunen

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