

High-Pulse Energy Supercontinuum Lasers for Multi-Spectral Photoacoustic Imaging Applications

Manoj Kumar Dasa^{1*} (ESR3), Christos Markos¹, Patrick Bowen², Peter M. Moselund², Ole Bang^{1,2}

1: Department of Photonics Engineering, Technical University of Denmark, 2800 Kgs. Lyngby, Denmark

2: NKT Photonics, Blokken 84, 2960 Birkerød, Denmark

Objectives

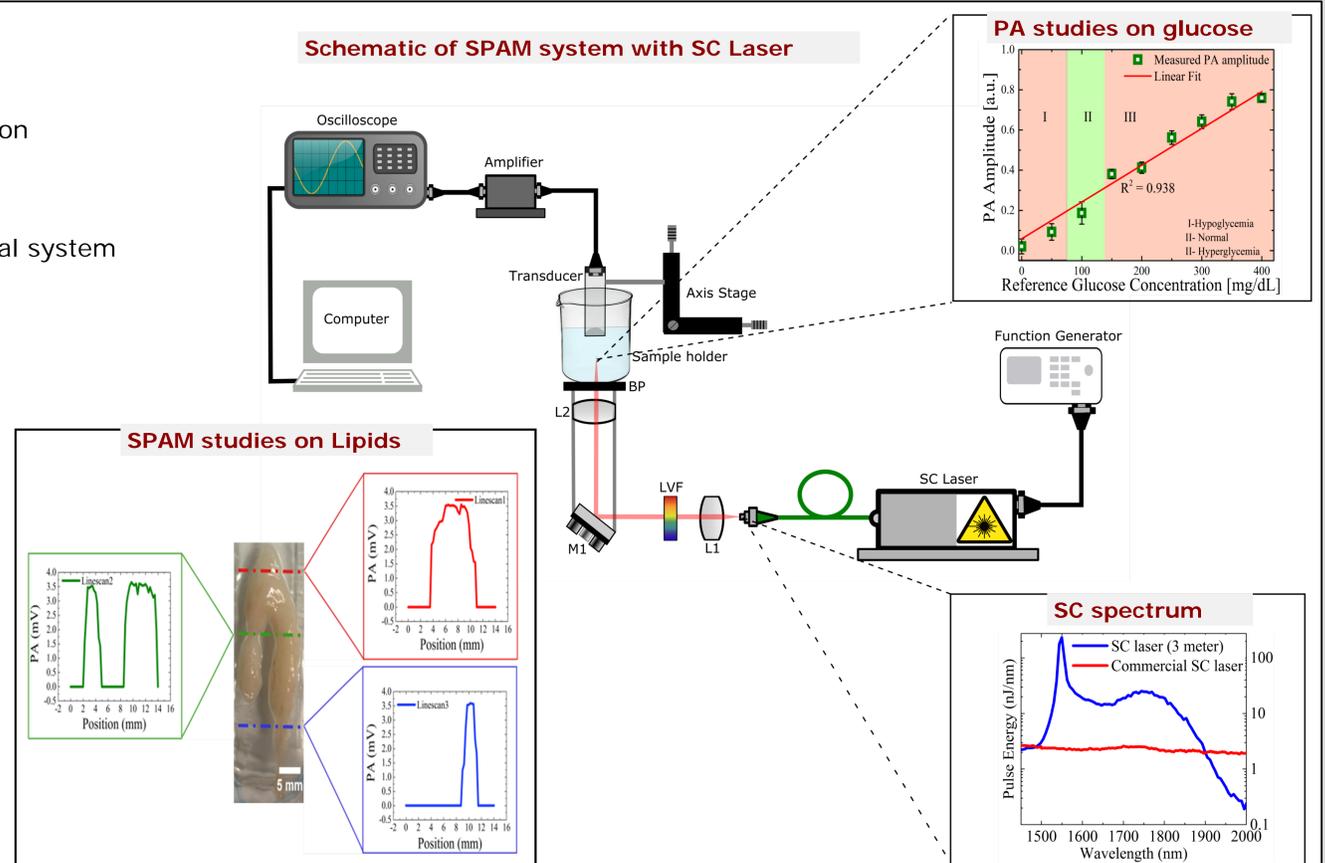
- ❑ Development of cost-effective high-pulse energy supercontinuum (SC) sources with
 - Pulse energy densities (PEDs) > 200 nJ over 10 nm bandwidth (5x PED of the current state-of-the-art SuperK Compact from NKT)
 - Repetition rates higher than the state-of-the-art SuperK Compact (Repetition rate of the SuperK Compact is 22 kHz)
- ❑ Demonstrate photoacoustic applications with the developed SC source
 - Spectroscopic photoacoustic microscopy (SPAM)
 - Multispectral photoacoustic sensing (MS-PAS)

Progress towards the objectives

- ❑ Development of cost-effective high-pulse energy supercontinuum (SC) source
 - ✅ 1st Approach Commercial EDFA and standard SMF
PED: 180 nJ over 10 nm bandwidth, Repetition rate: 30 kHz
ESR13 will use the following approach for his LIDAR based gas sensing
 - ✅ 2nd Approach Home-built EDFA and standard SMF (In Progress)
PED: 300 nJ over 10 nm bandwidth, Repetition rate: 50 kHz
- ❑ Photoacoustic applications
 - ✅ Manual SPAM system PA studies on Lipids (Should be automated)
Work published in Biomed. Opt. Exp. 2018
 - ✅ MS-PAS system PA studies on glucose
Work submitted to JOSA B 2018

Summary of Results

- ❑ 1st version of High-energy SC laser based on standard SMF
Output spectrum: 1500-1900 nm
- ❑ Pilot studies of SPAM on Lipids using manual system
- ❑ MS-PAS of glucose



Dissemination Activities

- ❑ Journal Publications
 1. Manoj K. Dasa, Christos Markos, Michael Maria, Christian Rosenberg Petersen, Peter M. Moselund and Ole Bang, "High pulse energy supercontinuum laser for spectroscopic optical resolution photoacoustic imaging of lipids in the 1650-1850 nm window," Biomed. Opt. Exp. 9(4), 1762-1770, 2018.
 2. Manoj K. Dasa, Christos Markos, Jakob Janting and Ole Bang, "Multi-Spectral Photoacoustic Sensing of Glucose using a Supercontinuum Laser," JOSA B (Submitted on 30 September 2018)
- ❑ Conference Proceedings
 1. G. Langer, B. Buchegger, J. Jacak, Manoj K. Dasa, T. A. Klar, T. Berer, "Photoacoustic microscopy of single cells employing an intensity-modulated diode laser," Proceedings Photonic West 2018 - Photons Plus Ultrasound: Imaging and sensing 2018: 104942L, San Francisco, USA, 19 February 2018. (oral presentation)
 2. Manoj K. Dasa, C. Markos, M. Maria, I. B. Gonzalo, C. R. Peterson, D. Jain, P. M. Moselund and O. Bang, "High Pulse Energy Supercontinuum Laser for Photoacoustic detection and Identification of lipids in the 1650-1850 nm Wavelength Region," CLEO: Applications and Technology, Optical Society of America, presentation ID: JTu2A.109, San Jose, USA, 15 May 2018. (dynamic E-poster presentation)
 3. Manoj K. Dasa, C. Markos, M. Maria, I. B. Gonzalo, C. R. Peterson, P. M. Moselund and O. Bang, "Supercontinuum Laser for Spectroscopic Photoacoustic Imaging of Lipids in the Extended Near- Infrared Region," Frontiers in Optics (FIO5.3), Optical Society of America, Washington DC, USA, 17 September 2018. (oral presentation)

Secondments

- ❑ RECENDT GmbH, Austria (1 week in M8)
To get acquainted with PAM system at RECENDT
- ❑ NKT Photonics A/S, Denmark (M21-M24)
To build high-energy SC source using the 2nd approach

Outreach Activities

- ❑ Talk on Medical Imaging using Light (Science Night 2017, Denmark)
20 participants (Pupils in schools/high schools and their parents)
- ❑ Organizer of IONS Scandinavia 2018 (Denmark and Sweden)
100+ participants (mostly Ph.Ds) from 12+ countries around the world

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