

**Institute of Atomic Physics and  
Spectroscopy**

**University of Latvia**

**Address:**

Šķūņu Street 4, Rīga, Latvia

**Mailing address:**

Raiņa Blvd 19, Rīga, LV-1586, Latvia

**Phone/fax:**

+371 67228249

**E-mail:**

asi@lu.lv

janispi@latnet.lv

**Webpage:**

<http://home.lanet.lv/~asi/fog-page.htm>

<http://www.lanet.lv/~spigulis>

**Staff**

**Prof. Jānis Spigulis,**



Dr. Habil. Phys.,  
Head of the laboratory

**Renārs Erts,**

Dr. Phys., leading researcher

**Aleksejs Ļihačovs,**

M Phys., researcher

**Ilona Kuzmina,**

M Phys., researcher

**Uldis Rubins,**

M Phys., researcher

**Edgars Kviesis-Kipge,**

M Phys., assistant

**Māris Ozols,**

B Phys., engineer

**Andris Grabovskis,**

B Phys., engineer

**Inga Širante,**

M Oec., finance manager

**Marija Mihanošina,**

M Oec., project administrator

Since 1986, the team works to promote research and education in the emerging field of new optical technologies in Latvia. A number of unique designs, components, and devices for optical fibre quality assessment, fibre-optic sensing, optical communications, illumination technology, laser medicine, and optical non-invasive diagnostics have been developed.

**Research application opportunities**

- Non-invasive optical assessment of human cardiovascular state
- *In vivo* spectroscopy of human skin
- Laser fluorescent analysis of skin and other bio-objects
- Side-emitting optical fibres ("laser snakes")
- Optical fibre designs for UV applications



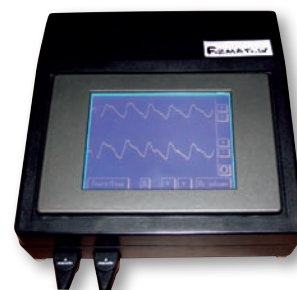
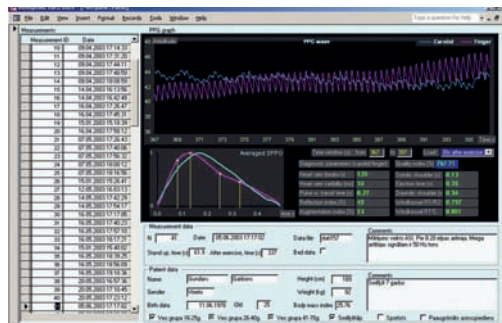
In the field of **bio-optics**, novel methods and optical technologies for health screening and monitoring have been developed, including

- detection/assessment of arterial occlusions in arms and legs,
- blood pressure real-time monitoring,
- heart rate and arrhythmia wireless real-time monitoring,
- analysis of pulse wave propagation in the arterial system,
- analysis of skin blood pulsations at different vascular depths,
- skin health assessment by diffuse reflectance spectrometry,
- parametric skin imaging (laser-excited skin fluorescence fading effects, hyperspectral imaging).



In the field of **fibre optics**, new designs of optical fibres and their products have been developed, including

- side-emitting ("glowing") silica core optical fibres – flexible linear light sources with unique properties for illumination, sensing, and artistic applications,
- illumination/irradiation systems comprising the "glowing" fibres, e.g. emergency light guides for explosive areas,
- specific optical fibres and fibre bundles for transport of ultraviolet (UV) radiation, including high-power UV laser radiation.



## Equipment

- A compact hand-held laboratory for clinical optical fibre spectrometry
- Multi-channel (2, 4, 5, 8) photoplethysmography devices for non-invasive detection of skin blood pulsations
- 2 prototype devices for optical detection of arterial occlusions in arms and legs
- 3 prototype devices for wireless cardiovascular monitoring using optical PPG sensors embedded in garments (hats, gloves, socks)
- High-quality hyperspectral imaging camera
- Infrared imaging camera
- Equipment for multi-wavelength reflection photoplethysmography



## Projects

- "Optical fibre medical instruments and sensor devices", grant of Latvian Council of Science, 1994–1996.
- "Potential of fibre optic sensors for medical monitoring", Royal Society London & King's College London, 1995.
- "Study and optimisation of the parameters of side-emitting optical fibres", project of the Ministry of Education and Science of the Republic of Latvia, 1995–1996.
- "Methods and devices for optical cardio-vascular monitoring", University of Latvia research project, 2004–2008.
- "Development of optical methods for functional diagnostics", scientific exchange program between Latvia and the USA (Columbia University), 2004.
- "Prospective biomaterials and medical technologies", Latvian state research project, 2005–2008.
- "New methods and technologies for production and application of optical fibres", ERDF project, 2006–2008.
- "Information technologies for optical cardio-vascular monitoring", ERDF project, 2006–2008.

## Patents

- D. Pfafrods, M. Stafeckis, J. Spigulis, and D. Boucher. Side-emitting optical fibre. Patent No. LV 11644 B (Latvia), 1995.
- J. Spigulis. Luminous fibre-optic cable and method for its manufacturing. Patent No. LV 12008 B (Latvia), 1996.
- J. Spigulis, R. Erts, I. Kukulis, M. Ozols, A. Lihachev. Method and device for detection of arterial occlusions in arms and legs. Patent No. LV 13449 B (Latvia), 2004.
- Z. Marcinkevics, M. Greve, R. Erts, J. Aivars, J. Spigulis. Method and device for non-invasive continuous measurement of arterial blood pressure. Patent Appl. No. P-05-162 (Latvia), 2005.
- J. Spigulis, R. Erts, I. Kukulis, M. Ozols, A. Lihachev. Method and device for detection of arterial occlusions in arms and legs. European Patent Application # EP 1671581A1, Bulletin 2006/25, 21/06/2006.
- J. Spigulis. Side emitting/detecting optical fibre and methods for its production. Patent Appl. No. P-07-132 (Latvia), 2007.

## Recent publications

- J. Spigulis. Optical non-invasive monitoring of skin blood pulsations. *Applied Optics*, Vol. 44, No. 10, 2005, pp. 1850–1857.
- J. Spigulis. Side-emitting optical fibers brighten our world in new ways. *Optics and Photonics News*, October 2005, pp. 34–39.
- R. Erts, J. Spigulis, I. Kukulis, and M. Ozols. Bilateral photoplethysmography studies of the leg arterial stenosis. *Physiological Measurement*, Vol. 26, 2005, pp. 865–874.
- J. Spigulis, L. Gailite, A. Lihachev, R. Erts. Simultaneous recording of skin blood pulsations at different vascular depths by multi-wavelength photoplethysmography, *Applied Optics*, Vol. 46(10), 2007, pp. 1754–1759.
- A. Lihachev, J. Spigulis. Skin autofluorescence fading at 405/532 nm laser excitation. *IEEE Xplore*, 10.1109/NO, 2007, pp. 63–65.
- I. Kuzmina, A. Lihachev, L. Gailite, J. Spigulis. Compact multi-functional skin spectrometry set-up. *Proc. SPIE*, Vol. 6596, 2007, pp. 6596OT1–6596OT6.
- L. Gailite, J. Spigulis, A. Lihachev. Multilaser photoplethysmography technique. *Lasers in Medical Science*, V. 23, 2008, pp. 189–193.
- J. Spigulis, R. Erts, V. Nikiforovs, E. Kviesis-Kipge. Wearable wireless photoplethysmography sensors. *Proc. SPIE*, Vol. 6991, 2008, 6991120.