A publication of the European Project

OASIS

Open the Access to Life Science Infrastructures for SMEs

Swedish Biophotonics

This OASIS project in funded by the European Union under the Information and Communication technologies (ICT) theme of the 7th Framework Programme.

SEVENTH FRAMEWORK PROGRAMME

PhotonicSweden

The Swedish Technology Platform in Optics and Photonics

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The OASIS project

OASIS – Open the Access to Life Science Infrastructures for SMEs

The OASIS project aims to improve the links between life science facilities, research projects and product development. The previous large investments in biophotonics are made more accessible to SMEs to allow a competitive advantage in new products development and validation.

Large scale research facilities and technology platforms are usually sets of laboratory equipment that are mainly available to academia and to a certain extent to industry. It can be very large-scale equipment, unique to a country or a continent as well as technological halls shared by a wide scientific and technological community, which develops competencies in a specific area.

In the field of the life sciences, the management of open access for researchers and world-class research programmes between these facilities is under consolidation through existing programmes like Instruct, EuroBioimaging, Biophotonics Plus and the network of excellence Photonics4Life.

Large companies have established strong collaborations with these facilities. However, there is still room for improving the economic outputs and the involvement of SMEs in order to create more value and jobs from early scientific results.

By February 2015, the OASIS consortium has inventoried and analysed about 120 companies, unmet needs from 14 hospitals and 14 agrifood companies and more than 70 Life Science facilities. Nine workshops are organised at each partners' premise during the life time of the project to promote exchanges and spread the information and results from the project.

Application areas addressed

Website: http://www.fp7-oasis.eu

Coordination and Support Action (CSA) project from FP7-ICT-2013-11 objective 3.2 Photonics.

Grant agreement no: 619230

9 Photonics clusters involved in the project:

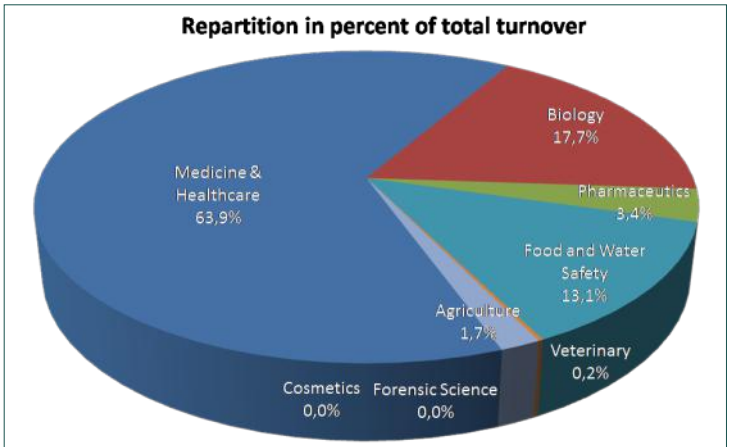
Optitec (Marseille, France); CNR – Optoscana (Florence, Italy); PhotonicSweden; OptecBB (Berlin-Brandenburg, Germany); Politecnico di Milano (Italy); SECPhO (Southern European Cluster in Photonics & Optics Association, Barcelona, Spain); Photonics NL (The Netherlands); Photonics Bretagne (Lannion, France) and Swansea University (UK).

Duration : 30 Months (Dec. 2013 to May 2016)

Coordination: Marie Lhoutellier, OPTITEC, Marseille.

Introduction - Swedish Biophotonics

Life Science: Sweden is the home of Carl von Linné and his cataloguing of the world's flora. It is also the country of several very important innovations in the life sciences such as e.g. the pacemaker, the gel filtration chromatography, the hemodialysis, Losec® and the lidocaine. The dynamic environment found in Sweden is also part of the very important human proteome project and a famous researcher from the Royal Institute of Technology (also affiliated to SciLifeLab), Prof. Mattias Uhlén, is responsible for the Human Protein Atlas program with the ultimate goal to characterize the expression, localization, modification of all the human proteins. Several leading global Life Science companies have established themselves in Sweden. The organisation SwedenBio estimates that about 30,000 people work in around 800 companies in the Swedish Life Science which stands for around 20% of net exports. It is probably worth mentioning that the Karolinska institute (KI), which is also part of the SciLifeLab, is by far the highest ranked academic environment in Sweden. In the Time Higher Education world university ranking 2014-2015, KI is ranked 44 as a whole and ranked 8 (first in Europe) by QS World university rankings by faculty (Life Science and Medicine).

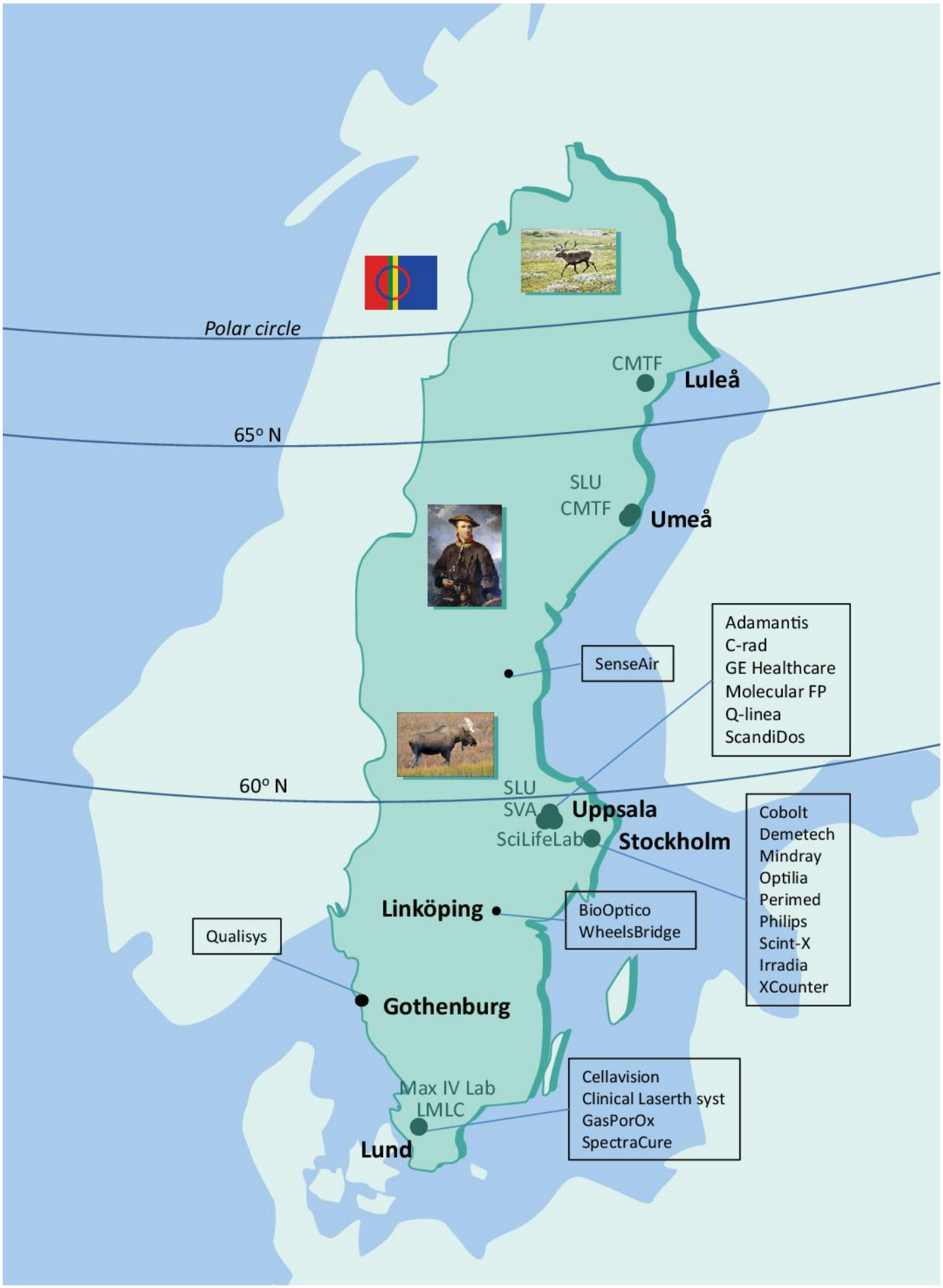


Repartition of the biophotonics companies in the 8 applications addressed by OASIS in terms of turnover

Life Science is a very important field for the largest regions of Sweden, before all the region of Stockholm-Uppsala region, but also Scania (Skåne) and the region of Gothenburg. Life Science is part of their regional strategies and in some cases integrated in the Smart Specialisation Strategy effort at the European level.

Biophotonics: The work group 3 of PhotonicSweden on the life sciences and health has been inventorying the Swedish actors for the Photonics research and innovation agenda published in December 2013. There are nearly 40 biophotonics companies and all of them have been approached by OASIS. The Figure beside shows how they address the targeted OASIS applications. In addition to these companies for which biophotonics is at the heart of their product, about 20 more companies have an important but not main part in biophotonics.

Most of the nearly 40 biophotonics companies are, or before acquisition by a large company, small- and medium-size enterprises (SMEs). Nearly all companies, even the large ones have seen their start in Sweden. The four largest companies are GE Healthcare Life Sciences AB, > 1600 employees among which about 200 work with biophotonics (which is based on the acquisition of Biacore AB by GE Healthcare in 2006), Philips Digital Mammography about 100 employees (Sectra Mamea acquired by Philips in 2011), Perten Instruments AB, about 250 employees (acquired by the American company Perkin-Elmer in 2014) and HemoCue AB, over 300 employees (presently owned by the Danish company Radiometer AS). The academic research and the collaboration with universities and institutes are at the origin of most, if not all, of these biophotonics companies. The couple Katarina and Sune Svanberg should have a particular mention here. Katarina and Sune Svanberg are both prominent researchers and professors from the university of Lund, Katarina in medicine and Sune in lasers and spectroscopy. They are, together with Prof. Stefan Andersson-Engels, at the origin of several companies (e.g. SpectraCure and GasPorOx) and of a very strong academic research in biophotonics (see the LMLC, Lund Medical Laser Centre). If a majority of the employees in the Swedish biophotonics companies are active in the application area medicine and healthcare, there is an incredible diversity of products from laser surgery and other kind of treatments to all sorts of diagnostic techniques.



Map of Sweden indicating the Life Science infrastructures (in green) and companies collaborating with OASIS. Only headquarters are indicated for companies.

Companies involved in the OASIS project

All these companies are described in more details later

Company name	Website	Data 2013		Location	Activity / Product
		Turnover in MSEK	#empl.		
Adamantis AB	www.adamantis.com	< 1	< 5	Uppsala	Develops and produces micro- and nanostructures in diamond for optical and life science applications.
BioOptico AB	www.biooptico.com	< 1	< 5	Linköping	Augmented reality tools for endoscopy. Arthroscopy and otoscopy, where tissue spectral characteristics are explored.
Cellavision AB	www.cellavision.com	180	67	Lund	Analyzers for automated medical digital microscopy analysis in hematology
Clinical Laserthermia Systems AB	clinicallaser.se	< 0	< 5	Lund	Light-generated heat treatment of cancers and imILT (Immunostimulating Laser Thermotherapy)
Cobolt AB	www.cobolt.se	65	29	Solna	Lasers in the UV/visible/NIR range based on diode-pumped solid-state crystals and laser diodes
C-rad	www.c-rad.info	49	26	Uppsala	Optical instruments for improving tumor localization and radiotherapy efficiency
Demetech AB	www.demetech.com	< 1	< 5	Täby	Dual X-ray and laser (DXL) systems for the diagnosis and early detection of osteoporosis
GasPorOx AB	gasporox.se	2	5	Lund	Optical instrument for detection of oxygen and others for process and quality control in the food, packaging and pharmaceutical industry.
GE Healthcare Bio-Sciences AB	www.gelifesciences.com	950*	200*	Uppsala	Optical techniques for characterisation in the bio-medical field. Previously Biacore (sensors based on SPR).
Mindray Medical Sweden AB	www.mindray.com/artema/	94	30	Sundbyberg	Respiratory gas measurement systems based on spectroscopy
Molecular Fingerprint Sweden AB	www.berzelii.uu.se/english/partners/Industrial-Partners	< 1	< 5	Uppsala	Develops a novel spectroscopic analysis method. specialized equipment for optical waveguiding. Part of Uppsala Berzelii Technology Centre for Neurodiagnostics
Optilia Instruments AB	www.optilia.eu	10	7	Sollentuna	Diverse instruments for inspection of human body and early diagnosis. Imaging tools for industrial applications.
Perimed AB	www.perimed-instruments.com	70	72	Järfälla	Equipment for microvascular diagnosis based on e.g. laser Doppler monitoring
Philips Digital Mammography Sweden AB	www.healthcare.philips.com	113	97	Solna	Equipment for mammography with soft X-rays
Q-linea AB	qlinea.com	23	7	Uppsala	Develops procedures, instruments, and systems for protein and nucleic acid analysis (microorganism detection and identification and for *in vitro* diagnostics). high-speed fluorescence detection
Qualisys AB	www.qualisys.com	55	24	Göteborg	Optical motion capture technology for medical and industrial applications
ScandiDos AB	www.scandidos.com	44	24	Uppsala	X-ray detection systems for improved visulation of tumors.
Scint-x AB	www.scint-x.com	3	6	Kista	Structured scintillators for digital x-ray detection systems with high resolution and contrast
SenseAir AB	senseair.com	116	97	Delsbo	CO_2 sensors based on IR absorption
SpectraCure AB	spectracure.com	2	< 5	Lund	Instruments for photodynamic or thermal therapy of solid cancers using multi-fibre for treatment and monitoring
Spectro Analytic Irradia AB	www.irradia.se	11	9	Stockholm	Medical lasers. Develops products and educates practicians
WheelsBridge AB	www.wheelsbridge.se	< 1	< 5	Linköping	Systems for skin (microvascular blood concentration) assessment based on polarized light imaging

*The estimation is that about 200 persons out of over 1600 in 2013 are working with biophotonics techniques. The turnover has been weighted with the same proportion (1/8).
**Two separate companies put together here: Perten Instruments and Perten Group.

Other Swedish companies

a. **Developing, selling or using biophotonics techniques:**
DDD North (NIR spectroscopy), Foss Analytical (optical characterization), Gyros (fluorescence in micro-fluidics), Heliospectra (LED lighting for plants), Hök Instrument (NDIR), LVI Low Vision International (imaging), Masimo Sweden (LWIR), Phase Holographic Imaging PHI (contrast microscopy), Prostalund (microwaves), Redsense Medical (fibre sensing), Servotek (absorption), UmBio (hyperspectral imaging), Xcounter (X-ray detectors).

b. **Having a biophotonics activity or division (but not the major part):**
Aerocrine, Autoliv Electronics, Biotage, Biolin Scientific (FTIR), Eclipse, Elekta, Elekta Instruments, FLIR Systems, Hamamatsu Photonics Norden, Maquet Critical Care, Maquet Nordic, Obducat, Olink, Optoga, Optronic, RTI ELecontrics, Serstech,Tobii Technology, ÅF.

Institutes, academic groups

These groups and organisations are described later

Name	Website	Geographic Location(s)
Acreo Swedish ICT (research institute)	**www.acreo.se/business-areas/life-science**	Stockholm (~4)
SP Technical Research Institute of Sweden	**www.sp.se/en/bizarea/lifescience/Sidor/default.aspx**	Mainly in Borås (~30)
Biological Physics, Chalmers Univ. of Techn.	**www.chalmers.se/ap/EN/research/biophysics**	Göteborg
BNP–Division of Bionanophotonics, Chalmers Univ. of Tech.	**www.chalmers.se/ap/EN/research/bionanophotonics**	Göteborg
Complex Systems and Biophysics, Univ. of Gothenburg	**www.physics.gu.se/forskning/komplexa-system**	Göteborg
Biomedical Instrumentation, Linköping Univ.	**www.imt.liu.se/bit**	Linköping
Biomedical & X-Ray Physics, Royal Inst. Tech. (KTH)	**www.biox.kth.se/**	Stockholm
Cell Physics, Royal Inst. Tech. (KTH)	**www.cellphysics.kth.se/**	Stockholm
Experimental Biomolecular Physics,Royal Inst. Tech. (KTH)	**www.biomolphysics.kth.se/**	Stockholm
Micro and Nanosystems, Royal Inst. Tech. (KTH)	**www.kth.se/ees/omskolan/organisation/avdelningar/mst**	Stockholm
Biophysics and Biophotonics Group, Umeå Univ.	**www.physics.umu.se/english/research/biological-physics/the-optical-tweezers-center/**	Umeå
Dpt. of Medical Cell Biology, Uppsala Univ.	**www.mcb.uu.se/**	Uppsala

Life Science infrastructures and other organisations

Life Science infrastructures collaborating with the EU project OASIS

(All these facilities are described later in this document)

Life Science Facility	Website	Main locations
SciLifeLab General	**www.scilifelab.se**	Stockholm&Uppsala
SciLifeLab - Advanced Light Microscopy	www.scilifelab.se/facilities/alm	Stockholm
SciLifeLab - Fluorescence Correlation Spectroscopy	www.scilifelab.se/facilities/fcs	Stockholm
SciLifeLab - Biological Visualisation	www.scilifelab.se/facilities/biovis	Uppsala
Lund Medical Laser Centre	www.mlc.lu.se	Lund
Centre for Biomedical Engineering and Physics	**www.cmtf.umu.se**	Umeå and Luleå
National Veterinary Institute	www.sva.se/en	Uppsala
Swedish University of Agricultural Sciences	www.slu.se/en	Uppsala and Umeå
MAX IV Laboratory	**www.maxiv.se**	Lund

Other Swedish facilities

SIK – the Swedish Institute for Food and Biotechnology (http://www.sp.se/foodbioscience)

Part of SP since January 1, 2015, SIK was before an independent industry institute. It conducts strategic and applied research on behalf of industry in accordance with an industry-driven research programme and in the form of joint projects.

Swedish National Laboratory of Forensic Science – SKL (http://nfc.polisen.se)

SKL is a Swedish government agency of the Department of Justice, tasked with assisting the Swedish police in investigating crimes. The Laboratory performs laboratory analyses of samples which have been taken from various types of crime scenes. The laboratory has expertise in most science disciplines and uses technology to find and preserve trace evidence and to establish links between people, places and objects.

Open facility for research on technologies for elderly people – SOFTEC (http://www.openlivinglabs.eu/livinglab/softec)

SOFTEC is the Swedish Open Facility for Technology in Elderly Care. Its goal is to provide a shared facility where Swedish and European researchers can jointly study, develop and evaluate technological solutions aimed at increasing the independence and quality of life of elderly people. SOFTEC is hosted by the School of Science and Technology of Orebro University.

Other Swedish networks and organisations

SwedenBio (http://www.swedenbio.se)
SwedenBIO is a trade association for the life science sector. Its members are active in the pharmaceutical industry, biotechnology, medical device and diagnostics. The 200 member companies, which together have more than 15,000 employees, represent a significant part of the industry (20% of Sweden's net exports.)

Swedish Bioimaging (http://www.bioimaging.se)
Swedish Bioimaging is a network aiming at facilitating collaboration between researchers in Sweden working in bioimaging and related fields. Bioimaging methods are today an integral part in both biomedical research and clinical practice, and spans the full spectrum from molecule to man.

CTMH – Center for Technology in Medicine and Health (http://www.ctmh.se)
Center for Technology in Medicine and Health, CTMH, is a cooperation between Karolinska Institutet (KI), Royal Institute of Technology (KTH) and Stockholm County Council (SLL) in order to help develop the Stockholm region as a world-class medical technology center. The activities of CTMH are workshops, open seminars, students' projects, speed dating and they have a clinical innovation fellowship programme.

Swednanotech (http://swednanotech.com)
SwedNanoTech is Sweden's first umbrella organization for the Swedish nanotechnology actors. The association was formed in 2010 to profile Sweden as a prominent nanotechnology country in research and products, but also as a land of investment opportunities. In spite of still some not fully solved safety issues, nanotechnologies find many new applications in life science.

SWElife (http://swelife.se)
SWElife is a so-called Strategic Innovation Programme (SIO) financed by several research funding agencies in Sweden. It addresses the area "Life Science against non-communicable diseases" and aims to stimulate a new kind of generic models for innovation. SWElife will address the entire value chain and all stakeholders aiming to develop new ways to prevent, diagnose, monitor, manage or treat patients with non-communicable diseases will benefit from the programme.

MedTech 4 Health (http://nfmt.se)
This is the latest Strategic Innovation Programme announced by VINNOVA on April 22, 2015. The Strategic Research and Innovation Agenda on which the programme is based can be found here: http://www.nfmt.se/wp-content/uploads/2012/08/MedTech4Health-a-research-and-innovation-agenda.pdf
The three presently existing SIO programmes, SWElife, MedTech 4 Health and Electronics Components and Systems complement each other's very well from basic technology to end-users via integration.

Other Relevant Strategic Research and Innovation Agendas:

1. **Personalized Medicine**: http://goo.gl/a4l6mb
2. E-hälsa I hemmet (**E-health at Home**, only in Swedish): http://goo.gl/bcSgEW
3. Vattenvisionen – Forsknings- och innovationsagenda för vattensektorn (**The Water Vision**, only in Swedish). http://goo.gl/1KVnXI
4. **How world-class diabetes research will contribute to Swedish growth**. http://goo.gl/nqZPDq
5. **Health and social care in the information society** (VOIS). http://goo.gl/wZGlYh
6. Åldrande befolkning (**Ageing Society**). http://goo.gl/2HwLbl

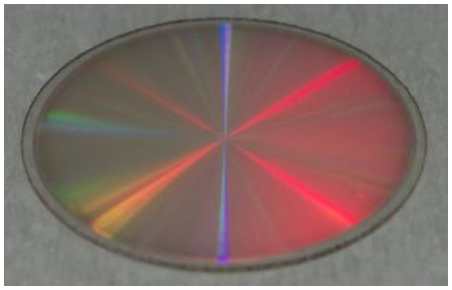
Description of 22 Swedish biophotonics companies

ADAMANTIS

Adamantis mainly develops and produces micro- and nanostructures in diamond for optical applications. Special focus is on so called sub-wavelength gratings for reducing surface reflection or controlling polarization properties. Adamantis is also working with diamond surfaces for bio-applications.

Adamantis works with all qualities of diamond – from single crystalline to nanocrystalline. Diamond has many unique characteristics such as transmitting light from UV to the far IR, providing high thermal conductivity, and being extremely durable and resistant against chemicals.

Contact: Mikael Karlsson (CEO), Uppsala - http://www.adamantis.com



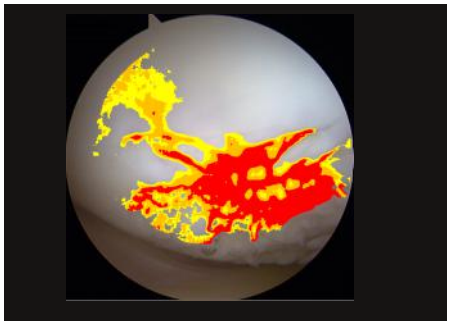
Circular sub-wavelength grating in diamond (substrate is 10 mm in ϕ and 0.3 mm thick)

BioOptico

BioOptico develops augmented reality video tools for the endoscopy market. Embedded software for endoscopy cameras is licensed to leading manufacturers. Important clinical information is derived and presented in real-time, directly into the endoscopy video stream. Main products are for arthroscopy, especially detection and quantification of cartilage lesions and visualization of degenerated cartilage.

BioOptico was founded by researchers at the Department of Biomedical Engineering at Linköping University.

Contact: Anders Johansson (CEO), Linköping - http://www.biooptico.com



CELLAVISION

CellaVision is an innovative, global medical technology company that develops and sells best-in-class systems for the routine analysis of blood and other body fluids. These analyses often provide critical results used in the diagnosis of a variety of illnesses such as infection and cancer. CellaVision's products reduce manual laboratory work, standardize results and support an efficient laboratory workflow. The company has leading-edge expertise in digital image analysis, artificial intelligence and automated microscopy. In 2014 sales were SEK 217 million and sales continue to increase..

Contact: Adam Morell, VP Engineering, Lund - http://www.cellavision.com

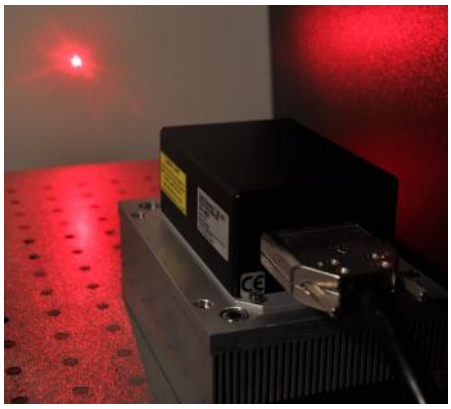
CLS

Innovator in Cancer Immunotherapy

Development, production, marketing and sales of a cancer therapy system using a medical laser system. The minimally invasive, thermal treatment is designed to achieve local tumor destruction and specific anti-tumor immunity. CLS relies on a network of specialized companies in different field (e.g. laser system, laser applicators, single use temperature measurements accessories). The laser applicators are tailored for different cancer types using optical fibers and optical solutions to convey light energy to the tumour in a controlled way.

Contact: Stephan Dymling (CTO), Lund - http://clinicallaser.se

Cobolt



Cobolt develops, manufactures and supplies diode-pumped solid-state lasers (DPSSLs) and Diode Laser Modules in the visible, invisible and near infrared spectral ranges. The company provides a broad range of market-adapted laser products built on a wavelength flexible, power-scalable and robust technology platform. The lasers are particularly suitable for OEM integration, but do also comply with applicable standards and directives for use as stand-alone devices in laboratory environment.

Cobolt's lasers find many applications in the life sciences, e.g. flow cytometry, fluorescence microscopy, optogenetics and DNA sequencing.

Contact: Jonas Hellström (CTO), Solna - http://www.cobolt.se

C-RAD

Development, production, marketing and sales of medical equipment for radiotherapy. Through detailed knowledge about the radiotherapy business and its customer requirements the C-rad group of companies (main and 3 subsidaries) offers products for positioning, monitoring, tumor localization and radiation therapy. C-rad has 4 main products:

- surface contour laser scanning system.
- detector system for tumor localization.
- radiation therapy system for efficient radiotherapy treatment.
- system for biologically optimized radiation therapy.

Contact: Tim Thurn (CEO) - http://www.c-rad.info

Scanflex | Demetech

Manufacturer of DXL Calscan, a peripheral bone densitometer scanning the heel with X-ray and using lasers. The result presented allows clinicians to estimate future risk of hip and other fractures and treat patients accordingly. The device uses 2 reflecting lasers to arrive at an exact laser measurement (per pixel) of the region of interest, which is also synchronized with 2 different x-ray energy scans (DXA). This enables the Calscan device to improve the accuracy of the DXA technique, which has well-documented errors inherent to its handling of the body's soft tissue components. It is one of the first uses of lasers in the medical field to precisely measure a part of the body.

Contact: John Elliott, (Lab/clinical studies), Stockholm - http://www.demetech.com

GASPOROX
INTELLIGENT LASER SOLUTIONS

Development and commercialization of laser-based (Tunable Diode Laser Absorption Spectroscopy) truly non-intrusive technology for gas monitoring in food and pharma packages as well as porous materials and food.

Also applications within other fields, such as medical diagnostics and agriculture.

Contact: Daniel Karlsson (Project leader) - http://gasporox.se

GE Healthcare Life Sciences

R&D, manufacturing and sales of equipment and services for life sciences research, discovery, development and manufacturing of pharmaceuticals and biologics. GE is using and developing photonic technologies for Biacore instruments, from the Swedish company acquired in 2006. The technology is based on surface plasmon resonance (SPR), enabling detection of unlabeled interactants in real time. For the characterization of molecular interactions in terms of both affinity and chemical kinetics. GE Healthcare's expertise is rooted in a heritage of chromatography, molecular imaging, and broad protein analytics.

Contact: Stefan Löfås (Science director), Uppsala - http://www.gelifesciences.com

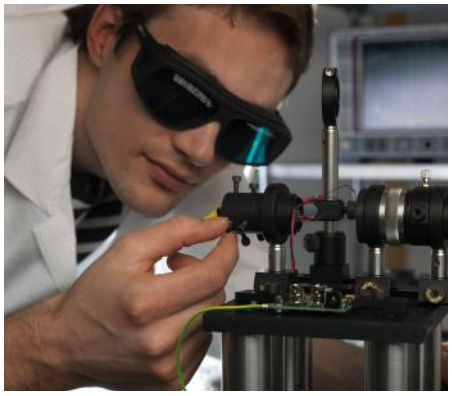
mindray

The Swedish site consists of two main departments

The sales department sells gas measurement technology on an OEM basis to Medical technology companies.

Respiratory gas measurements technology department. This department is highly specialized and develops technologies to measure gas properties for medical equipments, eg. concentration of CO2, anaesthesia gases and N2O. This department develops concepts and prototypes and after this the final product implementation are done at the main corporation.

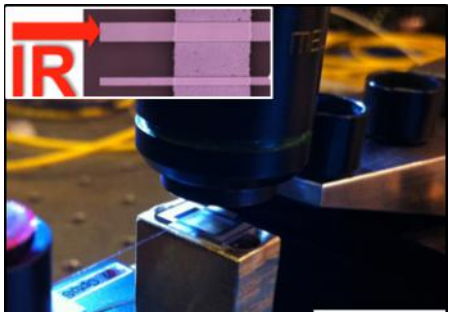
Contact: Johan Lidman (Lab manager), Stockholm - http://www.mindray.com/artema



Molecular Fingerprint Sweden

Molecular Fingerprint is a spin-off company from Uppsala University. It develops and manufactures ultra-sensitive infrared (IR) microchip diamond sensors for chemical and biochemical analysis. The company has an expert profile in diamond micro-fabrication and surface functionalization of diamond surfaces, optical biosensors, and infrared spectroscopy and analysis.

Contact: Lars O. Österlund (CEO), Uppsala



Optilia Medical

Design and manufacture of high-quality digital or video imaging systems but particularly where higher magnification is needed. Optilia delivers imaging solutions for inspection applications, where quality, precision and picture clarity are essential requirements for the customer. Optilia has products for industrial and laboratory applications e.g. inspection tasks or fine operations requiring magnification. Optilia systems also address medical applications and help detecting, analysing and documenting spots and areas of interest on the human body for early diagnosis.

Contact: Alistair Gooch (Manager, Medical products), Stockholm - http://www.optilia.eu

PERIMED

Perimed develops, manufactures and markets instruments for diagnosis of microcirculation. Perimed's product portfolio contains instruments that measures blood flow in one single point or over a tissue surface using a laser Doppler technique. It also contains instruments that measure oxygen and carbon dioxide through the skin (transcutaneous). Perimed instruments have been used many research projects generating more than 1500 publications and more than 100 doctor theses all over the world. Perimed is moving more and more over to the clinical area (today 50% of the turn over comes from the clinical part).

Contact: Hans-Eric Aaltonen (R&D Manager), Stockholm - http://www.perimed-instruments.com

PHILIPS

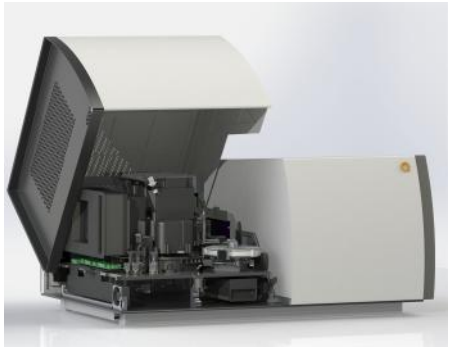
Philips Digital Mammography Sweden AB is part of Royal Philips, a diversified health and well-being company, focused on improving people's lives through meaningful innovation in the areas of Healthcare, Consumer Lifestyle and Lighting. The activities in Solna are mainly related to research and development of Philips MicroDose mammography. Philips MicroDose is based on photon-counting x-ray detectors and offers reduced radiation dose without compromising image quality. In addition, photon-counting technology enables one-shot spectral imaging, which holds promise of providing new insights into breast composition.

Contact: http://www.healthcare.philips.com

q-linea

Q-linea develops systems for molecular analysis in diagnostics and biosecurity.
Based on a novel and proprietary molecular platform, Q-linea develops fully automated, high-throughput systems for infectious disease diagnostics, delivering both pathogen identity and antibiotics susceptibility within hours from sample taken. For biosecurity applications Q-linea has developed a technology based on a universal platform for molecular sample analysis, offering detection of both proteins and nucleic acids. The system has successfully demonstrated automated, on-line identification of air-borne agents simulating biothreats in the Prague subway.

Contact: http://qlinea.com



Q-linea Aquila 1000 biosecurity system

QUALISYS

Qualisys is a leading, global provider of products and services based on optical motion capture. The core technology of Qualisys products has been developed in Sweden since 1989. At its heart, you will find the Oqus camera and the motion tracking software, Qualisys Track Manager. Qualisys develops and markets motion capture systems to customers in biomechanical applications, industrial applications as well as media and entertainment. In-house expertise in camera development and software development to create a complete end-user package.

Contact: Magnus Berlander (CTO), Gothenburg - http://www.qualisys.com

ScandiDos

Scandidos provides the quality assurance (QA) technology that ensures radiation doses in advanced radiation therapy are delivered to the patient in the quantity and manner that was intended. The company's measurement systems and software are designed to meet QA requirements and provide validation of the new cancer radiation treatments being implemented in clinics around the world. ScandiDos, founded in 2002, operates worldwide (40 countries). The company's systems can be found in well-known cancer centers throughout the United States.

Contact: Kjell Lundgren (VP Engineering), Uppsala - http:/www.scandidos.com

SCINT-X
STRUCTURED SCINTILLATORS

Scint-X has developed a highly differentiated, proprietary MEMS scintillator technology to significantly improve X-ray imaging. The patented structured scintillator technology is based on deep pores etched in silicon, which are oxidized and filled with scintillating material. The pores act as waveguides, leading light to the right pixel in the imaging sensor. Unlike conventional scintillators, any stray light does not reach the imaging sensor, which greatly improves the image quality.

Contact: Olof Svenonius (CTO), Stockholm - http://www.scint-x.com

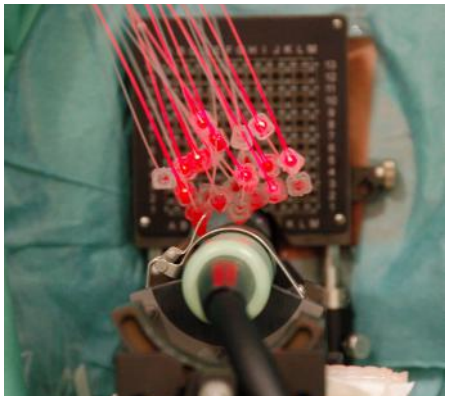
SenseAir
Sensors for Life

SenseAir is an innovation-based gas sensor company and a world-leading manufacturer of IR gas sensors and controllers. One of the major markets is building automation where SenseAir sensors control individual fans, dampers, valves etc. In addition, complete air-handling and air-conditioning units help creating a better indoor environment and energy savings. With over 20 years' experience SenseAir has acquired a large and broad technology base and unique know-how in production methods for gas meters and has become a world leader in the field of IR gas measurement technology.

Contact: Hans Martin (CTO), Delsbo - http://senseair.com

SpectraCure

SpectraCure is a research-oriented medical device company devoted to development of embedded laser systems for photodynamic therapy in the oncology sector. SpectraCure develops advanced methods for treatment planning and laser light dose management for cancer treatment. The method, interstitial photodynamic therapy (PDT), utilizes a laser light source, optical fibres and a photosensitizing drug. This technology is suitable for internal cancer tumours such as prostate cancer and pancreatic cancer. SpectraCure has developed a sophisticated software IDOSE®, as well as medical laser devices for this purpose.



Contact: Johannes Swartling (CTO), Lund - http://spectracure.com

Irradia

Kirurgiska och medicinska lasrar

Development, manufacturing, sales, training and support of Medical Laser Devices. Spectro Analytic Irradia AB, founded 1978, is a Swedish medical technology company specialized in laser medicine and development of medical laser devices.

Contact: Stefan Jordison (CEO), Stockholm - http://www.irradia.se

WheelsBridge

Wheelsbridge develops, brings to market and sells patented polarization spectroscopy camera systems (generally called Tissue Viability Imaging) for assessment of skin microcirculation and other skin parameters. Our main and best market is currently the US, but we are also active in Europe and Asia. Our customers are mainly found among the skin care product development companies, skin test houses and university departments. Our expertise is mainly within the field of light scattering in tissue, as well as within the fields of software and hardware development and production.

Contact: Prof Gert Nilsson (Founder, director), Linköping - http://www.wheelsbridge.se

Description of 9 Life Science infrastructures

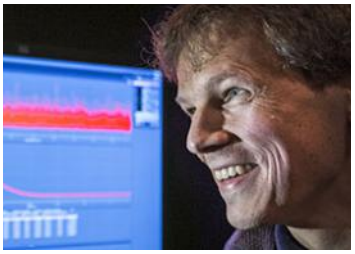
SciLifeLab is a national centre for molecular biosciences with focus on health and environmental research. The centre combines frontline technical expertise with advanced knowledge of translational medicine and molecular bioscience. SciLifeLab is a national resource and is jointly hosted by four universities: Karolinska Institutet, KTH - Royal Institute of Technology, Stockholm University and Uppsala University. SciLifeLab is located at two main nodes: Stockholm and Uppsala. It engages about 200 research groups and 1500 researchers. The operations include, among other things, the national genomics infrastructure, a growing drug development platform, unique resources in protein analyses and many other techniques. The centre has an emphasis on health applications, but environmental applications are growing. The centre feature a number of national facilities, among which the bioimaging platform is the most relevant one for photonic technologies (its two facilities are described below) but photonic technologies, in particular microscopy and fluorescence excitation and detection, are found in many other facilities. There are also relevant regional facilities funded by the respective University, e.g. Biovis in Uppsala, which are relevant for biophotonics and Biovis is also described below.

SciLifeLab

Advanced Light Microscopy (ALM) National Facility

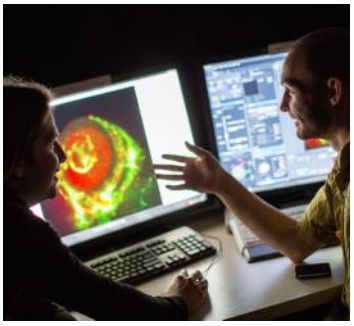
This facility gives open-access to state-of-the art superresolution fluorescence microscopy for nanoscale biological visualization. The facility offers access to commercially available super-resolution techniques (STED, PALM/STORM, SIM) and to experimental techniques such as easy-STED and QD-SPT. Access also includes specific superresolution specimen preparation and data analysis. Collaborative project management and transfer of unique knowledge to individual researchers are supported nationally, including organization of national workshops and courses in superresolution microscopy.

Fluorescence Correlation Spectroscopy (FCS) National Facility



FCS measures concentrations and sizes of biomolecules as well as interactions between biomolecules, in solution or in living cells. The FCS facility at Scilifelab offers access to the latest developments in FCS and related techniques to all researchers at universities in Sweden. Support is given in the design and planning of experiments as well as in performing measurements and interpreting and analyzing the experimental data. Projects are usually carried out as scientific collaborations between the respective research groups and the national FCS facility.

Biological Visualization (BioVis) Regional facility of national interest



BioVis provides the means to place genomic and proteomic information in a cellular or tissue context. It provides technology & expertise for high-resolution biological imaging. The imaging techniques include brightfield, fluorescence, confocal, multiphoton, superresolution and lightsheet microscopy, as well as electron microscopy and (imaging) flow cytometry. For upstream sample purification, flow sorting is provided. Advices regarding methods and visualization-related problems are also given. Advanced image analysis can be performed on site or in conjunction with the centrum for image analysis.

Lund Medical Laser Centrum

The Lund Medical Laser Centre is an umbrella organization at the Lund University for co-ordination of research and teaching in the field of laser applications to medicine. Departments belonging to four faculties at the Lund University participate in the Centre.

The building of the Centre followed a long informal collaboration in Lund between physicians and physicists, showing that interdisciplinary work strongly promotes a rapid development in new emerging fields. The Lund University Medical Laser Centre is part of the Lund Laser Centre (LLC).

LMLC's expertise is in laser spectroscopy, laser-induced fluorescence for diagnostic purposes, photodynamic therapy of prostate cancer, in vivo monitoring of human tissue, and industrial applications such as spectroscopy of pharmaceutical materials and food. A common factor is the spectroscopic and optical analysis of complex, highly scattering materials such as biological tissue and porous pharmaceutical solids.

Director of LMLC is Prof. Stefan Andersson-Engels.

Contact: ***http://www.mlc.lu.se***

National Veterinary Institute (SVA)

Security Laboratorty

The National Veterinary Institute (Statens veterinärmedicinska anstalt, SVA) is a Swedish government agency that answers to the Ministry of Enterprise and Innovation. The agency was established in 1911 and is located in Uppsala.

The agency strives for good animal and human health, a good environment and sustainable food production. It is specialised in virology, bacteriology, resistance to antibiotic, parasitology, chemistry, food safety, vaccinology and pathology. It provides advice and conducts commissioned investigations and programmes for controlling contagious diseases. One of the main commissions is zoonotic infections. 70% of the activities (and the incomes) are related to contractual services and 30% to the role of SVA as an authority. SVA has about 80 researchers out of totally 400 employees.

Contact: ***http://www.sva.se***

Centre for Biomedical Engineering and Physics

The Centre for Biomedical Engineering and Physics (CMTF) serves as a platform for excellent research in the field of biomedical engineering in northern Sweden. Through CMTF collaborations between research groups at Umeå university and Luleå technical university, the industry and the university hospital are created with the goal of new technology and innovations and grows of business in the area of health care.

Contact: Britt Anderson (coordinator) - ***http://www.cmtf.umu.se***

Swedish University of Agricultural Sciences (SLU)

The Swedish University of Agricultural Sciences (SLU) is a university with comprehensive knowledge of the sustainable use of biological natural resources, as well as of the environmental and life sciences.

Our activities span from genes and molecules to biodiversity, animal health, bioenergy and food supply. Urban and regional planning, sustainable urban and rural development and global issues such as climate change are also on the agenda.

SLU's work is about how biological natural resources from forests, soil and water can be used without exhausting them and while preserving welfare for humans and animals alike. This is the fundamental principle that permeates the education, research and environmental monitoring and assessment at SLU.

SLU's knowledge is sought-after both by decision-makers and by the green sector (agriculture, forestry, fisheries etc.).

Contact: http://www.slu.se

Max IV Lab

MAX IV Laboratory is a national laboratory hosted by Lund University. It operates accelerators producing x-rays of very high intensity and quality. More than 1000 scientists per year come to the lab to use the x-rays for scientific research in the fields of materials science, physics, chemistry, the geosciences and Life Sciences in general, on materials including macromolecules, functionalized surfaces, semiconductors, and nanomaterials. It is presently building a new facility, the MAX IV, which will be the brightest x-ray source in the world when opening to users in 2016.

When offering access to companies, e.g. SMEs, it is crucial with training, collaborations extending past single measurements, and dialogue. MAX IV encourages the use of research service providers acting as an intermediate link to address these needs. Research service providers specialize on performing the measurements for industry and bring with them an understanding of what problems can be solved in order to address the business needs.

Contact: http://maxlab.lu.se

Academic Groups (Complementary list)

Below, a non-exhaustive list of academic groups with a clear biophotonics profile, and not already covered via the earlier described life science facilities, is given. In this list there is therefore no group from Lund and Uppsala and only one from Stockholm (apparently not part of SciLifelab).

University of Gothenburg, Inst. of Physics, Complex syst. and biophysics, Biophotonics group
http://www.physics.gu.se/forskning/komplexa-system/biophotonics
Expertise: Laser based optical manipulation; Tailored microfluidic structures and pumping systems; Advanced optical imaging and spectroscopy techniques.

Chalmers University of Technology (Gothenburg), Applied Physics Dept.

Biological physics group
http://www.chalmers.se/en/departments/ap/research/biologicalphysics/Pages/default.aspx
Expertise: surface-sensitive tools: quartz crystal microbalance with dissipation (QCM-D), ellipsometry, surface plasmon resonance (SPR), nanoplasmonics, bioimaging using total internal reflection fluorescence (TIRF).

Bionanophotonics group
http://www.chalmers.se/en/departments/ap/research/bionanophotonics/Pages/default.aspx
Expertise: plasmons in metal nanostructures and their interactions with molecules and other nanoobjects.

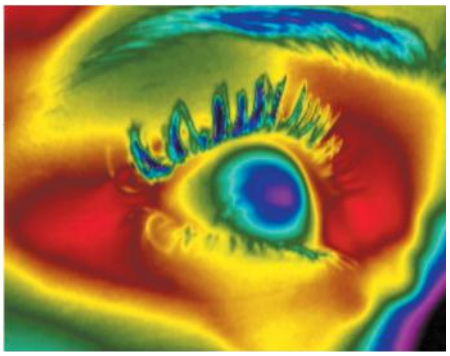
University of Linköping, Faculty of Health Sciences, Medical Image Science
http://www.hu.liu.se/forskning/medicin/medicinsk-bildvetenskap/medicinsk-bildvetenskap?l=en
Expertise: Quality assurance of medical X ray imaging systems; Quantitative tissue classification via spectral and multi-energy CT and most non photon-based visualisation techniques.

Royal Institute of Technology (KTH, Stockholm), School of Electrical Engineering, Micro and Nanosystems (MST)
https://www.kth.se/en/ees/omskolan/organisation/avdelningar/mst
Expertise: Micro- and Nanoelectromechanical Systems (MEMS/NEMS) e.g. applied to the medical (MedMEMS), biotechnology (BioMEMS), optical (OptoMEMS) and radio frequency (RFMEMS) fields or combination of these.

University of Umeå, Department of Physics, The Biophysics and Biophotonics group
http://www.physics.umu.se/english/research/biological-physics/the-optical-tweezers-center/
Expertise: optical tweezers for single cell manipulation and single macro-molecule force spectroscopy, characterization of bacterial attachment organelles.

Research institutes

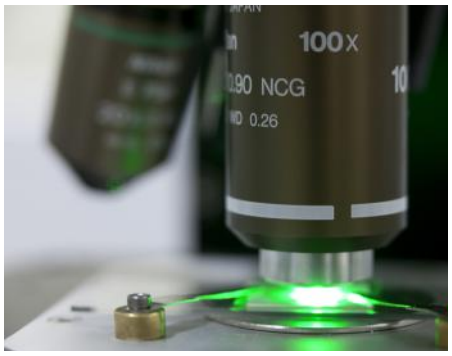
Acreo Swedish ICT



Acreo Swedish ICT, a Swedish research institute within electronics, optics and communication technologies, offers a Multi-disciplinary Innovation environment to take Life Science research concepts to manufacturable prototypes. Our focus is upon diagnostics and detection, research tools and eHealth-solutions. Examples of technologies relating to photonics include: image sensors (Wavelengths X-ray to Thz and IR) optic sensors including fiber optics as well as nanoelectronics. Since life science is a truly interdisciplinary area of research, we think it is especially important for us, as sensing developers, to work in close proximity to professionals with various scientific disciplines, ranging from clinicians to academy and industry researchers. We can assist in any stage of bringing new ideas to the market. We have the technology competence, we have the laboratories and test environments, we know prototyping, licensing and patents. And we have strong national and international networks – academic as well as business networks.

Contact: Sara Bogren, Business Manager Life Science

SP Technical Research Institute of Sweden



SP Technical Research Institute of Sweden works with testing, verification, calibration and research in a multitude of technical areas. This enables a possibility to assess and develop with knowledge and experience from both the application side and the enabling technologies. Of the 1400 employees, more than 400 have a post-graduate degree.

In Photonics, SP is the National Metrology Institute with traceable calibration of optical parameters, standardized testing and research based on innovative measurement techniques.

From the application side SP also works with

- GLP approved cell laboratory (member of EU-NETVAL)
- Microbiology
- Biocompatibility
- In vivo models
- Formulation
- Imaging
- Additive manufacturing / 3D-printing
- Measurement technology and quality

SP is an experienced partner in Swedish Vinnova supported SME projects, as well as coordinator of several publicly funded research projects, e.g. EU H2020.

The measurement facilities are ISO 17025 accredited.

Conclusions

This brochure is to our knowledge the first gathering of nearly all companies, academic groups and institutes active in the field of biophotonics in Sweden. This work could be realised by PhotonicSweden thanks to its participation in the European project OASIS. The project aims at reinforcing the field of biophotonics in Europe. A brochure like this one is certainly an important contribution to that aim. Photonics in Europe is highly fragmented and the level of fragmentation is probably even higher in the field of biophotonics. Most actors have only a few employees and a serious difficulty in performing a number of activities related to e.g. communication, information and networking. Our hope is that the different actors gathered in this publication will have the pleasure and maybe the surprise to discover the impressive diversity found in Sweden. They might also realise that some other companies, without being direct competitors, have similar trajectories or markets and have a similar interest in knowing more about the needs from end-users. It is the belief of the photonics clusters, and PhotonicSweden is no exception, that photonics companies have a lot to gain in helping each other' and cooperating with each other. They can share useful information about market and end-users' needs, technology transfer processes, regulations, pre-clinical and clinical trials, etc. A lot of efforts are occurring at the European level, probably more than at the national or regional levels. Photonics has been selected in 2009 as one of six key enabling technologies (KETs) by the European Commission and this decision has a major impact on the financing of the research and innovation in photonics and similar impact will happen on an industry, although made of many small players, with an overall annual growth that many other industrial sectors are just dreaming of. A brochure like this one will be an efficient material to be visible on the European scene and to get involved in projects, not the least European ones. The brochure will be an excellent promotion material towards politicians to show all that exists in our country and make them understand that the field of biophotonics is highly relevant to tackle major societal challenges like safer food and ageing society and that it has a large potential of growth.

Introducing new technologies in the life sciences and especially in the health sector takes particularly much time. Improving the communication between the end-users and technology providers is an obvious key. There are several organisations and actors contributing to this effort, e.g. CMTF and CMTH in Sweden, but much more needs to be done. The OASIS project contributes to connecting companies, especially SMEs, with life science infrastructures throughout Europe. This brochure presents the Swedish infrastructures which have accepted to collaborate with the project and it is our hope that their dialogue with photonics technology providers starting now will be fruitful and enriching for all parts. This, of course, does not apply to the Lund Medical Laser Centre which many years ago started from that dialogue.

PhotonicSweden

TPhotonicSweden is:

- the Swedish national platform in optics and photonics (founded in 2011)
- an economic association with 50 member organisations and about 110 personal members.
- a legal entity with a work force consisting of three consultants and that can be part of research projects.

PhotonicSweden's vision:

- Optics and Photonics having a strong impact on a viable, expanding and profitable Swedish industry based on research and innovation.

PhotonicSweden shall:

- catalyze fruitful cooperation between companies, universities, and institutes in the field of optics and photonics in Sweden and across the national borders.
- be a natural partner for Swedish and European funders and investors for product development and research.
- contribute to a healthy regrowth of engineers in optics and photonics.
- increase the awareness among the general public and politicians of the strategic importance of optics and photonics for the future of Sweden.

Contacts:

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- Petra Bindig petra@photonicsweden.org +46 70 264 46 63
- Lennart Svensson lennart@photonicsweden.org +46 70 726 74 11

Photonics is a transboundary enabler within many fields, not the least for Swedish areas of strengths such as telecoms, automation, security and medicine. Today, the Swedish photonics community consists of over 150 high tech companies with over 6000 employees, and many research groups all around the country.

The conditions are very favourable for biophotonics, the use of photonic technologies for bio/medical applications mostly because of the exceptionally strong research activities in that field in our country. The biophotonics field in Sweden is highly fragmented, even more than the Swedish photonics as a whole. We expect the Swedish biophotonics to have a substantial growth during the coming years, higher than average, but the community needs an increased visibility, stronger links in the value chains, i.e. a better collaborations between the different actors and even at the European level. The community also needs to make sure that enough the supply of skills will be sufficient to ensure the expected growth.