

**SKIN AND TISSUE CANCER DETECTION
USING LASER IMAGING
The Book of Scientific Reports**

**Edited by Željka Cvejić, Jelena Radovanović, and
Dragan Indjin**



Skin and tissue cancer detection using laser imaging: The Book of Scientific Reports

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Preface

The recent advances in optical sources and detectors have opened up new opportunities for sensing and imaging techniques and biomedical and healthcare applications. *BMBS COST Action BM1205 project* “European Network for Skin Cancer Detection using Laser Imaging” is an interdisciplinary international framework to enhance interaction and research activities within the field of optical biosensing, between world-class academic groups, labs and system integrators from industry. The network exploits novel laser sources and innovative spectroscopy and interferometry techniques in specific biomedical imaging applications. Recent developments in the design of solid-state laser sources at near-infrared, mid-infrared and terahertz frequencies, coupled with novel self-mixing approaches to signal detection and the integration of these into imaging platforms, provide a way forward in the design of the next generation of detection systems. Specifically, project proposed extending the noninvasive interrogation of skin tissue into these frequencies. The Action exchange knowledge, explore and compare technology platforms and perform clinical validation and evaluation of new devices which will permit detection of both the changes in skin and human tissue in general, and disordered blood flow patterns and tissue perfusion typical of malignancy. The COST scheme turn to be an ultimate choice for this network as brings together COST-countries academia, industry and clinical end-users, which would be virtually impossible through any other European funding mechanism.

Much of this innovative networking was of an inter-disciplinary nature thus contributing to one of the purposes of the Action. A key mechanism of research networking within the project were Short Term Scientific Missions (STSMs) which were allowing scientists to go to a lab in another COST member state to foster collaboration, share new infrastructure, learn a new technique or to perform measurements using instruments and methods not available in their own institution. STSMs are intended especially for young researchers, however senior members or head of research teams were also encouraged to visit project partner institutions to establish new or enhance existing collaboration. The involvement of female and early stage investigators in these BM1205 COST Action’s activities was excellent with the latter significantly involved in more than 60 STSMs realized over the project’s 4-years long lifetime. STSMs strongly supported establishment and increased interaction between physics, laser and biophotonics research communities and clinical dermatology and histopathology partners. That was indeed one of the key aims of this project. This book presents a selection of BM1205 Action STSM research reports, evaluated and approved by project’s Management Committee.

An original idea of the project around optical feedback interferometry for skin sensing and imaging was expanded towards development and improvement of other techniques for optical/laser skin and human tissue cancer detection, i.e. use of Optical Coherence Tomography, THz time domain spectroscopy, Raman spectroscopy, Confocal microscopy, etc. In particular, key achievements include: an imaging and tissue analysis scheme in the THz band that exploits the interferometric nature of coherent optical feedback in a THz quantum cascade laser, which offers the possibility of earlier and potentially more powerful discrimination than is currently

possible in the visible and infrared regions of the spectrum; THz time domain spectroscopy and reflection imaging of carcinoma-affected tissue; design of optical phantoms for the purpose of simulating human skin tissue at the wavelength of 930 nm and development of an optical measurement techniques with accuracy and the sources of errors in microscopic parameters; the use of confocal microscopy in specific clinical cases where additional evaluation of skin tumor was indicated, in particular analysis of recurrent pigmented melanocytic tumors; development of techniques for designing and optimising mid-infrared and THz laser sources and their use in sensing/imaging applications. These are indeed a break-through scientific developments leading to new concepts and prospective products, thereby contribute to strengthen Europe's (and world's as whole) research and innovation capacities.

COST (European Cooperation in Science and Technology) is a pan-European intergovernmental framework. Its mission is to enable break-through scientific and technological developments leading to new concepts and products and thereby contribute to strengthening Europe's research and innovation capacities.

It allows researchers, engineers and scholars to jointly develop their own ideas and take new initiatives across all fields of science and technology, while promoting multi- and interdisciplinary approaches. COST aims at fostering a better integration of less research intensive countries to the knowledge hubs of the European Research Area. The COST Association, an International not-for-profit Association under Belgian Law, integrates all management, governing and administrative functions necessary for the operation of the framework. The COST Association has currently 36 Member Countries. COST's mission focuses in particular on:

- Building capacity by connecting high quality scientific communities throughout Europe and worldwide;
- Providing networking opportunities for early career investigators;
- Increasing the impact of research on policy makers, regulatory bodies and national decision makers as well as the private sector.

Through its inclusiveness, COST supports the integration of research communities, leverages national research investments and addresses issues of global relevance. Every year thousands of European scientists benefit from being involved in COST Actions, allowing the pooling of national research funding to achieve common goals. As a precursor of advanced multidisciplinary research, COST anticipates and complements the activities of EU Framework Programmes and Horizon2020, constituting a "bridge" towards the scientific communities of emerging countries. In particular, COST Actions are also open to participation by non-European scientists coming from neighbour countries and from a number of international partner countries. COST's budget for networking activities has traditionally been provided by successive EU RTD Framework Programmes. COST is currently executed by the European Science Foundation (ESF) through the COST Office on a mandate by the European Commission, and the framework is governed by a Committee of Senior Officials (CSO) representing all its 36 member countries. More information about COST is available at www.cost.eu.

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