SpringerBriefs in Applied Sciences and Technology

Zhengbin Hu · V. T. Bachinsky · O. Y. Vanchulyak · Iryna V. Soltys · Yu. A. Ushenko · A. G. Ushenko · Igor Meglinski

Phase Mapping of Human Biological Tissues

Data Processing Algorithms for Forensic Time of Death Estimation

Springer

SpringerBriefs in Applied Sciences and Technology

SpringerBriefs present concise summaries of cutting-edge research and practical applications across a wide spectrum of fields. Featuring compact volumes of 50 to 125 pages, the series covers a range of content from professional to academic.

Typical publications can be:

- A timely report of state-of-the art methods
- An introduction to or a manual for the application of mathematical or computer techniques
- A bridge between new research results, as published in journal articles
- A snapshot of a hot or emerging topic
- An in-depth case study
- A presentation of core concepts that students must understand in order to make independent contributions

SpringerBriefs are characterized by fast, global electronic dissemination, standard publishing contracts, standardized manuscript preparation and formatting guidelines, and expedited production schedules.

On the one hand, **SpringerBriefs in Applied Sciences and Technology** are devoted to the publication of fundamentals and applications within the different classical engineering disciplines as well as in interdisciplinary fields that recently emerged between these areas. On the other hand, as the boundary separating fundamental research and applied technology is more and more dissolving, this series is particularly open to trans-disciplinary topics between fundamental science and engineering.

Indexed by EI-Compendex, SCOPUS and Springerlink.

Zhengbin Hu · V. T. Bachinsky · O. Y. Vanchulyak · Iryna V. Soltys · Yu. A. Ushenko · A. G. Ushenko · Igor Meglinski

Phase Mapping of Human Biological Tissues

Data Processing Algorithms for Forensic Time of Death Estimation

Springer

Zhengbin Hu
School of Computer Science
Hubei University of Technology
Wuhan, China

O. Y. Vanchulyak
Bukovinian State Medical University
Chernivtsi, Ukraine

Yu. A. Ushenko
Chernivtsi National University
Chernivtsi, Ukraine

Igor Meglinski
School of Engineering and Applied Science
Aston University
Birmingham, UK

V. T. Bachinsky
Bukovinian State Medical University
Chernivtsi, Ukraine

Iryna V. Soltys
Chernivtsi National University
Chernivtsi, Ukraine

A. G. Ushenko
Chernivtsi National University
Chernivtsi, Ukraine

ISSN 2191-530X ISSN 2191-5318 (electronic)
SpringerBriefs in Applied Sciences and Technology
ISBN 978-981-99-3268-9 ISBN 978-981-99-3269-6 (eBook)
https://doi.org/10.1007/978-981-99-3269-6

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd.
The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Acknowledgement

This work received funding from: National Research Foundation of Ukraine, Grant 2020.02/0061 and Scholarship of the Supreme Council for Young Scientists—Doctors of Sciences.

Introduction

Currently, forensic practice requires a significant update of the methods for TDE, since the existing methods depend on many environmental factors and the circumstances of death. The existing lack of modern, objective methods for determining the TDE prompts the search and development of new methods for studying the main BT of a person after death [1–19].

Non-invasive optical methods for diagnosing BT structure using a complex of photometric, polarization, spectral and correlation techniques are promising in this direction. The indicated methods of studying the phenomenon of light scattering by BT by their macro inhomogeneities make it possible to search for interrelationships between the dynamics data after mortal changes in the studied body tissues of certain organs with a set of objective photometric, polarization, spectral and correlation parameters of their optical images. On this basis, the possibilities open up for an objective and more accurate determination of the time interval that has passed since the death of a person. This approach is implemented in the spectral photopolarimetric method of laser optics, based on the use of polarization of laser beams of various wavelengths and modeling by matrix operators of the properties of tissues or hematomas of human organs of any type [20–34]. From a forensic medical point of view, it is advisable to carry out a complex spectral photopolarimetric laser study of images of the main types of BT of a human corpse in time dynamics, which is promising for the determination of TDE.

So, the relevance of this monograph is due to the need to develop new approaches to the determination of TDE, the search and development of a complex of new methods for objective spectral phase laser diagnostics and monitoring of changes in the parameters of the main types of human BT for the development of objective criteria for the forensic medical definition of TDE.

Purpose of the Study

The aim was to develop a set of new forensic methods and objective criteria for establishing the antiquity of the onset of death and the time of hematoma formation by means of a phase study of the temporal dynamics after death changes in laser images of histological sections of BT and hematomas of human organs.

To achieve this goal, the following tasks should be addressed:

1. Development of the basic principles of phase measurement of microscopic images of the main types of BT of human corpse organs to determine the time of death.
2. Investigation of the possibilities of complex laser spectral-selective phase measurement of images of histological sections of the main types of biological tissues of a human corpse in various spectral regions for establishing the TDE.
3. Development and justification of a set of statistical criteria for the objective determination of TDE.

Object of study: changes in the phase properties of laser spectral images of the main types of human BT in the post-mortem period.

Subject of study: spectral phase measurement of images of the main types of human BT after death; temporal dynamics after mortal changes in BT of human organs and changes in the phase and statistical parameters of their spectral laser images.

Research methods: microscopy (image of histological sections of BT in polarized laser light at different wavelengths); polarimetry (measurement of coordinate distributions of azimuths and polarization ellipticity, parameters of the Stokes vector of BT images and elements of their Mueller matrix); phase measurement (measurement of coordinate distributions of phase shifts of spectral laser images of BT of human organs); statistical processing of research results.