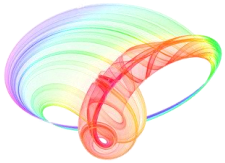
Book of abstracts



PHOTONICA2019

The Seventh International School and Conference on Photonics, 26 August – 30 August 2019, Belgrade, Serbia

& Machine Learning with Photonics Symposium (ML-Photonica 2019)

& ESUO Regional Workshop

& COST action CA16221

Editors: Milica Matijević, Marko Krstić and Petra Beličev

Belgrade, 2019

ABSTRACTS OF TUTORIAL, KEYNOTE, INVITED LECTURES, PROGRESS REPORTS AND CONTRIBUTED PAPERS

of

The Seventh International School and Conference on Photonics
PHOTONICA2019, 26 August – 30 August 2019, Belgrade, Serbia

and
Machine Learning with Photonics Symposium

and
ESUO Regional Workshop

Editors
Milica Matijević, Marko Krstić and Petra Beličev

Technical Assistance
Danka Stojanović and Goran Gligorić

Publisher
Vinča Institute of Nuclear Sciences
Mike Petrovića Alasa 12-14, P.O. Box 522
11000 Belgrade, Serbia

Printed by
Serbian Academy of Sciences and Arts

Number of copies
300

ISBN 978-86-7306-153-5

PHOTONICA2019 (The Seventh International School and Conference on Photonica-www.photonica.ac.rs) is organized by Vinča Institute of Nuclear Sciences, University of Belgrade (www.vinca.ac.rs), Serbian Academy of Sciences and Arts (www.sanu.ac.rs), and Optical Society of Serbia (www.ods.org.rs).

Institute of Nuclear Sciences Vinča

Serbian Academy of Sciences and Arts

Optical Society of Serbia

Other institutions that helped the organization of this event are: Institute of Physics Belgrade, University of Belgrade (www.ipb.ac.rs), School of Electrical Engineering, University of Belgrade (www.etf.bg.ac.rs), Institute of Chemistry, Technology and Metallurgy, University of Belgrade (www.ihtm.bg.ac.rs), Faculty of Technical Sciences, University of Novi Sad (www.ftn.uns.ac.rs), Faculty of Physics, University of Belgrade (www.ff.bg.ac.rs), and Faculty of Biology, University of Belgrade (www.bio.bg.ac.rs). Joint event "Machine learning with Photonics Symposium" has been co-organized with programme partners H2020-RISE-CARDIALLY, H2020 – MULTIPLY and H2020-EID-FONTE.

PHOTONICA2019 is organized under auspices and with support of the Ministry of Education, Science and Technological Development, Republic of Serbia (www.mpn.gov.rs). PHOTONICA2019 is supported and recognized by OSA - The Optical Society (www.osa.org), Integrated Initiative of European Laser Research Infrastructures Laser Lab-Europe (www.laserlab-europe.eu) and European Physical Society (www.eps.org).

Ministry of Education, Science and Technological Development of the Republic of Serbia

OSA The Optical Society | 100 Since 1916

Laserlab Europe

EPS

The support of the sponsors of PHOTONICA2019 is gratefully acknowledged:

Microsoft Development Center Serbia

AMERICAN ELEMENTS THE ADVANCED MATERIALS MANUFACTURER®

THORLABS

NKT Photonics

OptoSigma

Telekom Srbija

mks Spectra-Physics | Ophir® | mks Newport®

Ocean Insight | laservision

Represented by LRM Ljubljana / Slovenija

Optical Society of Serbia

CENTER FOR THE PROMOTION OF SCIENCE

Defibrillation outcome prediction as a potential guide to resuscitation

M. D. Ivanovic[1], M. Ring[2], J. Hannink[2], F. Baronio[3], Lj. Hadzievski[1] and B. Eskofier[2]
[1]*Vinca Institute of Nuclear Sciences, University of Belgrade, Belgrade, Serbia*
[2]*Machine Learning and Data Analytics Lab, Friedrich-Alexander University of Erlangen-Nuremberg, Erlangen, Germany*
[3]*CNR and Department of Information Engineering, University of Brescia, Brescia, Italy*
e-mail: marijap@vin.bg.ac.rs

Ventricular fibrillation (VF) represents the most frequent initial rhythm in out-of-hospital cardiac arrest (OHCA). It is characterized by rapid and disorganized contraction of the heart muscle cells which can lead to a sudden cardiac death. Optimizing defibrillation strategy (immediate defibrillation versus cardiopulmonary resuscitation) by evaluating the probability of the successful outcome could significantly enhance resuscitation.

Over the past few decades, different classification strategies were applied to predict the defibrillation outcome of OHCA patients, but none have achieved superior performance to be widely accepted and implemented in automated external defibrillators. All these reported strategies utilized conventional machine learning (ML) approach with feature engineering. Here, we compare the performances of 7 ML algorithms (Logistic Regression (LR), Naïve Bayes (NB), Decision tree (C4.5), AdaBoost M1(AB), Support Vector Machine (SVM), k Nearest Neighbour (kNN) and Random Forest (RF)) [1] with a novel approach based on convolutional neural networks (CNN). For conventional ML approach we engineered 28 "hand-crafted" features using time domain, frequency domain, time-frequency domain and non-linear dynamical analysis of the 4s pre-shock VF signal. The best performing feature combination was chosen using the wrapper feature selection method, which utilizes the classifier in evaluating selected feature subset. In deep learning approach, the CNN was capable of learning useful features from the raw VF signals. We used 3-stage CNN feature extractor, which contained convolution, rectified linear unit activation, dropout (only in training) and max-pooling and 2 layer perceptron for classification.

Our results show that the SVM, kNN and RF outperformed other conventional ML algorithms. The mean accuracy obtained over 10 fold cross-validation of these 3 ML algorithms were: 81.5%, 81.8 % and 82.8 %, respectively. On the other hand deep learning approach demonstrated the superiority over the conventional ML approach with engineered features. Obtained averaged accuracy of 93.6 %, along with sensitivity of 98.8 % and specificity of 88.2 %, which satisfy the condition of at least 50 % specificity at 95 % sensitivity for being considered safe, indicate that the proposed CNN model can be considered as a safe and useful predictor for defibrillation decision.

REFERENCES

[1] M. D. Ivanovic et al., Biomed. Phys. Eng. Express 5, 015012 (2019).