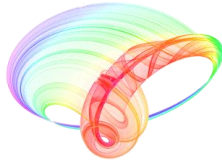


# Book of abstracts



## 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



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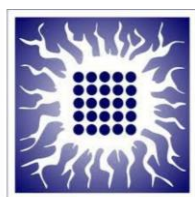
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## Deep learning based classification of high intensity light patterns in photorefractive crystals

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Extreme events (EE) continue to challenge researchers in diverse fields of natural and social sciences [1]. The traces of different dynamics of huge intensity light events recently observed experimentally on the output facets of a SBN photorefractive crystal were challenge of this kind for us. We investigate the statistical properties of high intensity events by adopting the standard methods of the EEs detection and classification [2]. It was shown that these events were inevitable in our experiment for a large set of parameters, which was confirmed by a simple theoretical model based on the two-dimensional Schrödinger equation with saturable nonlinearity. We distinguished two main EE regimes, one with speckles pattern and another one with soliton-like structures.

In order to classify different EEs regimes we used the achievements of the deep learning methods applied in various fields of science and implemented them in the EE framework [3]. We applied the convolution neural network (CNN) architecture consisting of the 3-stage feature extractor and a fully connected multi-layer perceptron to classify different high light intensity profiles. These profiles were formed in the experiment and in the corresponding numerical simulations of the light propagation through the SBN crystal [2]. Each feature learning stage incorporated the convolution, ReLU nonlinear activation and max-pooling. Three high intensity profiles: caustic-, soliton- and speckling-like were confronted to the linear dispersion one (i. e. no RW regime). The train and test sets of data were formed from the light intensity profiles. The network architecture and optimal hyperparameters were selected using 10 fold cross-validation. The model performances were evaluated on the blindfolded test set after the model was trained on the whole training set. When the combination of theoretical and experimental data were considered, the overall accuracy of selecting the soliton and speckling regimes, which can be associated with different types of extreme events was above 97%. The caustic regime which can be considered as a nucleus of high intensity events was extracted correctly from the other regimes, too with the accuracy of 97.51 %. Satisfying performances of the CNN based detector and classifier of the high intensity events were an encouraging outcome for continuing the study. We are interested in going towards the prediction of the system preferences for the formation of high intensity events using the deep learning strategy, since these events usually have a devastating effect in the systems.

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