COMPLEX-VALUED DEEP NEURAL NETWORKS

Goal of the project

Three types of complex-valued deep neural networks will be proposed: complex-valued convolutional neural networks, complex-valued deep belief networks and long short term memories, which will be applied for image recognition and time series prediction with real values and with complex values.

Short description of the project

The project aims to extend deep neural networks to the complex domain, and use the resulting complex-valued deep neural networks for real- and complex-valued image recognition and time series prediction.

Implementation period

21.11.2017 – 31.12.2018

Budget

46.500 RON (10000 EUR)

Main activities

The main activities of the project are:

- Development and application of deep complex-valued convolutional neural networks,
- Development and application of complex-valued deep belief networks,
- Development and application of complex-valued long short term memories,
- Dissemination of the results and support of the research activities.

Results

The main results of the project were: 5 papers in ISI conferences:

- **3 at the International Symposium on Neural Networks (ISNN),** Minsk, Belarus, 2018:

1. C.-A. Popa, C. Cernăzanu-Glăvan, Fourier Transform-Based Image Classification Using Complex-Valued Convolutional Neural Networks;
2. C.-A. Popa, Complex-Valued Stacked Denoising Autoencoders;
3. C.-A. Popa, Complex-Valued Deep Belief Networks;

- **2 at the International Joint Conference on Neural Networks (IJCNN),** Rio de Janeiro, Brazil, 2018:

1. C.-A. Popa, Deep Hybrid Real-Complex-Valued Convolutional Neural Networks for Image Classification;
2. C.-A. Popa, Complex-Valued Deep Boltzmann Machines;

- **and 2 papers in ISI journals:**

1. C.-A. Popa, Deep Hybrid Real–Complex-Valued Residual Networks, IEEE Access, IF 3.557, Q1;
2. C.-A. Popa, Global μ-Stability of Neutral-Type Impulsive Complex-Valued BAM Neural Networks with Leakage Delay and Unbounded Time-Varying Delays, Neurocomputing, IF 3.241, Q1.

Applicability and transferability of the results:

The results are applicable in the radar imaging and the functional magnetic resonance imaging domains, which both produce complex-valued images, where complex-valued neural networks can have better results than their real-valued counterparts. Wind speed and direction prediction is a complex-valued time series prediction problem, for which the proposed complex-valued neural networks may also have a positive impact. As such, the results can be interesting for the military, medical, and metrological domains.

Research team

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Contact information

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