DEEP NEURAL NETWORK MODELS FOR DYNAMIC RESILIENCE ESTIMATION OF A COMPLEX WATER SYSTEM UNDER HAZARDS

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Abstract

The paper investigates feed-forward deep neural networks (DNNs) for estimating dynamic resilience of water resource system affected by unpredictable and dangerous events. Besides different architecture of DNNs, hyper-parameters' values were also explored in order to examine the way they affect the performance of DNNs. The aim of this research was to investigate the capabilities of DNNs in domain of water resources resilience estimation to provide significantly better results than currently developed ANN models from literature. The DNN models were trained and tested using large, generated dataset related to the Pirot water system. In order to generate data, an appropriate model of system dynamics was used alongside MonteCarlo simulations. The dataset contained two hazardous events: flood and earthquake defined in wide range of situations (nearby 2,000), from moderate to severe ones. The efficacy of examined DNNs were evaluated using average error metric as well as time required for training and execution.

Keywords: deep neural networks, dynamic resilience, water resources.

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WELCOME MESSAGE

Dear colleagues and students,

On behalf of the Organizing Committee, it is a pleasure to welcome you at the Third Serbian International Conference on Applied Artificial Intelligence AAI2024 which takes place in Kragujevac, Serbia, on May 23rd-24th, 2024 at the University of Kragujevac.

AAI2024 provides an exceptional Serbian and international forum to share the state-of-the-art research knowledge and results on the innovative theories, methodology and applications of artificial intelligence and its sub-domain like deep learning, machine learning in different areas such as medicine, economy, education, law, smart city, government, industry etc. Moreover, the conference aims to provide a platform for researchers and practitioners for both academia and industry to share the information about cutting-edge developments in the field of artificial intelligence.

It also aims to:

- provide early-stage researchers with an inspiring event allowing them to connect to relevant experts in related fields;
- provide an exciting venue for researchers to network and establish national and international collaborations;
- bring together leading experts from all relevant scientific domains to enhance the understanding of *Artificial Intelligence*;

Topics cover the following:

AI IN DOMAIN-SPECIFIC APPLICATIONS

- AI in Computational Biology, Medicine and Biomedical Applications
- AI in WWW, Communication, Social Networking, Recommender Systems, Games and E-Commerce
- AI in Finance and Risk Management

AI IN DATA ANALYTICS AND BIG DATA

- Visual Analytics for Big Data
- Computational Modeling for Big Data
- Large-scale Recommendation and Social Media Systems
- Cloud/Grid/Stream Data Mining for Big Velocity Data
- Semantic-based Big Data Mining

MACHINE LEARNING AND DATA MINING

- Pre-processing, Dimension Reduction and Feature Selection Computing, Bayesian and Neural Networks
- Learning Graphical Models and Complex Networks
- Active, Cost-Sensitive, Semi-Supervised, Multi-Instance, Multi-Label and Multi-Task Learning
- Transfer/Adaptive, Rational and Structured Learning

There are seven different mini-symposiums:

- **MS1: AI in Energy and Environmental Science**
  Organizers: **Boban Stojanović**, Faculty of Science, University of Kragujevac, Kragujevac, Serbia; **Nikola Milivojević**, Water Institute Jaroslav Cerni, Belgrade, Serbia; **Milan Stojković**, The Institute for Artificial Intelligence R&D of Serbia, Novi Sad, Serbia.
- **MS2: AI & IOT for Smart Industry**
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- **MS3: AI in Computer Vision and Remote Sensing**
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- **MS4: AI and Social Wellbeing**
  Organizers: **Ljubiša Bojić**, The Institute for Artificial Intelligence R&D of Serbia, Novi Sad, Serbia; **Milan Čabarkapa**, Faculty of Engineering, University of Kragujevac, Serbia; **Igor Pantić**, Faculty of Medicine, University of Belgrade, Serbia.
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- **MS6: Delivering on The Promise of AI to Improve Health Outcomes**
  Organizers: **Tijana Geroski**, Faculty of Engineering, University of Kragujevac, Serbia; **Nenad Filipović**, Faculty of Engineering, University of Kragujevac, Serbia.
- **MS7: Heritage Mining: Theory and Examples**
  Organizers: **Veljko Milutinović**, Guest Lecturer and Former Faculty, Purdue University, USA Adjunct Professor, University of Indiana in Bloomington, USA, Adjunct Professor, Technical University of Graz, Austria Visiting Professor, University of Kragujevac Visiting Professor, University of Belgrade Visiting Professor, University of Montenegro.

As well as seven world renowned plenary speakers in the area of applied artificial intelligence:

- **Prof. Amir A. Amini –** University of Louisville, Louisville, Kentucky, USA; **Title: 4D Flow MRI: Efficient Acquisition and Deep Learning Strategies for Assessment of Hemodynamics**
- **Prof. Borko Furht –** Florida Atlantic University, Boca Raton, Florida, USA; **Title: Successful Engineering Education Requires Applied Industry Projects**
- **Prof. Themis Exarchos –** Ionian University, Corfu, Greece; **Title: Using Explainable AI (xAI) to Predict the Conversion from Mild Cognitive Impairment to Alzheimer's Disease**
- **Prof. Emil Jovanov –** University of Alabama at Huntsville, USA; **Title: Integrating AI and IoT for Personalized Healthcare**
- **Prof. Dubravko Ćulibrk –** University of Novi Sad, Novi Sad, Serbia; **Title: AI-disrupted Medicine and How to Apply it in Serbia**
- **Prof. Israel Koren –** University of Massachusetts in Amherst, USA; **Title: Protecting Vehicle Privacy against AI-Enhanced Attackers in Intelligent Transportation Systems**
- **Prof. Zoran Obradović –** Temple University, Philadelphia, Pennsylvania, USA; **Title: Characterizing Disruptive Events by Modeling Dynamics in Multiplex Networks**

We have received more than 180 high-quality research papers. As a result of the strict review process and evaluation, the committee selected over 100 papers as extended abstracts.

After the review, full papers from the AAI2024 conference will be published by Springer Verlag in the series “Learning and Analytics in Intelligent Systems” under the title “Applied Artificial Intelligence”.
We must also admit that the conference certainly would not have been so successful without the efforts of many people who were actively engaged in organization of such a major academic event. We express gratitude to the members of the program and scientific review committee as well as to all the chairs, organizers and committee members for their dedication and support.
On behalf of the Organizing Committee, we wish you all a pleasant stay in Kragujevac and a productive conference.

Prof. Nenad Filipović, Conference Program Chair

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