

EDUARDO PIGNATELLI

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EDUCATION

1. Doctor of Philosophy

University College London

November 2020 to **present**

Subject: Credit Assignment in Deep Reinforcement Learning

I am conducting research on the empirical Credit Assignment Problem in Reinforcement Learning, on how *credit* can be formally defined, and how to assign credit in Reinforcement Learning with Large Language Models. The position is funded by the Engineering and Physical Sciences Research Council (EPSRC).

2. Master of Science in Architecture

University of Naples Federico II

2015

Subject: Architecture and Engineering

Final grade: **110 Con Lode** / 110, and mention for publication

Average grade: **29.167 / 30**

I defended the thesis "Computational morphogenesis and construction of an acoustic shell for outdoor chamber music".

Implementing numerical methods that uses geometrical acoustics, computational physics, descriptive geometry and genetic algorithms, the thesis presents a novel generative method to design a passive acoustic shell for outdoor classical music. Both in silico results and on-site measurements show that it outperforms the state of the art of the design of outdoor acoustic chambers.

EXPERIENCE

1. Research Assistant

Imperial College London

September 2019 to November 2020

I conducted research to shorten the computational time for predictive modelling of surgical interventions in cardiology. Statistical modelling, specifically deep learning, is central in the approach. The deep networks take advantage of accepted numerical modelling techniques to generate training data and are optimised to infer approximate solutions in about 1% of time necessary to standard models. The position was founded by the Rosetrees Trust, in collaboration with the ElectroCardioMaths program, a multidisciplinary initiative that brings together the National Heart and Lung Institute, and the Departments of Bioengineering, Aeronautics, Computing and Physics to address key challenges in the diagnosis and treatment of complex cardiac arrhythmia. Skills: Python, Jax, Flax, Pytorch, GPU computing, Git, Numerical methods, Predictive modelling.

2. Machine Learning and Decision Analytics Lead

BuroHappold Engineering

August 2018 to October 2020

I led the applied research in Machine Learning to help understand how AI can create value for the business. We democratised the access to Deep Learning technologies to allow every employee to access the knowledge and the tools. We exploited Visual Programming, a recognised and diffused tool for design, to create a framework that interoperates between the most common deep learning libraries, tensorflow, keras, pytorch, numpy. The position was part of the wider computational core team that brings together discipline leads into a centralised research team [bhomxyz](https://github.com/bhomxyz). The BHoM is currently adopted in different companies and is at the base of the project funded by Innovate UK, github.com/aecdeltas, which I advise for. Skills: Line management, Risk management, Planning, C#, Python, Deep learning, NoSql, Keras, Pytorch, jupyterhub.

3. Computational/Machine Learning Engineer

BuroHappold Engineering

August 2017 to August 2018

For 50% of my time, I have been applying deep learning for computer vision to the analysis of security footage for the Premier League. To monitor the number of standing fans during a football match we created a database of more than 400,000 annotated images and trained a convolutional deep network to identify them. We then exploited principal component analysis, hierarchical clustering and bespoke data visualisation to gather insights from the resulting probability distribution. For the remaining 50% of my time, I have been designing a framework for data sharing and co-creation in design, for the architecture, engineering and construction industry, [bhomxyz](https://github.com/bhomxyz). We created a software-agnostic model to link together the capabilities of existing software and allow seamless interoperability between them. A short-cycles, distributed scrum development model, and an entity-component-system architecture allowed independent contributions from more than 50 users. My main responsibility has been to lead the UI and support the framework leadership of the project. Skills: Python, Supervised learning, Unsupervised learning, NoSql, Tensorflow, Pytorch, Azure, Cloud computing, Docker, C#, JavaScript, Git, Agile development, SCRUM, UI, UX, MongoDB.

4. Intern Computational Engineer

BuroHappold Engineering

April 2017 to August 2017

I provided computational support for the Stadia Atmosphere project and helped introduce deep learning into the current offer for sports venues design. We used pre-trained deep neural networks for Natural Language Processing to perform sentiment analysis on news

regarding a specific football team. Skills: Python, Visual programming, C#, MongoDB.

5. **Architect**

Gianni Ranaulo Design

September 2016 to December 2016.

I provided support for the parametric modelling of a façade in a multi-purpose shopping centre. Skills: Visual Programming, Geometrical modelling, Image processing, Rendering.

6. **Computational Architect**

Gridshell.it

September 2015 to September 2016

I conducted research on the application of computational tools to recover the use of traditional low-tech construction techniques. I used generative modelling to provide cost-effective, environmentally efficient, and functionally viable structure. Using genetic algorithms, particle-spring system models and dynamic relaxation we designed and built 13 prototypes of timber post-formed gridshells. Taking advantage of recognised acoustic modelling techniques, we generatively designed three temporary acoustic shells for outdoor classical concerts, the last of which has won the Peter Lord Award. Skills: Python, Numerical methods, Physics, Differential Equations, Spectral analysis, Acoustical modelling.

7. **Computational Architectural Assistant**

Gridshell.it

July 2014 to September 2015

8. **Intern Architect**

CRC – Constructions Restorations and Consolidations

September 2012 to December 2012

I provided support for the preparation of compliance documentation for a multi-storey parking building. My main responsibility was to ensure the fire compliance of the building.

TEACHING EXPERIENCE

1. **Teaching consultant**

Imperial College for Sberbank

March 2020 to March 2021

Class: **Computer Vision and Image retrieval** Within the executive education program for **Sberbank** I discussed scalable object recognition methods using vocabulary trees and deep convolutional neural networks.

2. **Teaching Assistant**

University College London

March 2020 to present

Classes:

- **UCL-COMP0089: Reinforcement Learning**
- **UCL-ELEC0136: Data Acquisition and Processing Systems**

3. **Teaching Assistant**

University College London Consultants for Defence Science and Technology Laboratory

January 2021 to present

Classes:

- **Machine Learning**
- **Deep Reinforcement Learning**

With UCL Consultants, I taught a practical application of Deep Reinforcement Learning to the governmental agency responsible for the **UK defence and security**.

PUBLICATIONS

1. **Pignatelli, E.**, Toni, L., 2024. NAVIX: Accelerated gridworld navigation with JAX. <https://github.com/epignatelli/navix>. In preparation.
2. **Pignatelli, E.**, Ferret, J., Paglieri, D., Coward, S., Tim Rocktäschel, Edward Grefenstette, Toni, L., 2024. Assessing the Zero-Shot Capabilities of LLMs for Action Evaluation in RL. **ICML Workshop on AutoRL**. In review.
3. **Pignatelli, E.**, Ferret, J., Geist, M., Mesnard, T., van Hasselt, H., Toni, L., 2024. A Survey of Temporal Credit Assignment in Deep Reinforcement Learning. Accepted at **TMLR**.
4. A. Kayal, **Pignatelli, E.**, Toni, L., 2023. Does Behavioural Diversity in Intrinsic Rewards help Exploration?. In **NeurIPS Second Agent Learning in Open-Endedness Workshop**.
5. Ntagiantas, K., **Pignatelli, E.**, Peters, N. S., Cantwell, C. D., Chowdhury, R. A., Bharath, A. A., 2023. Estimation of Fibre Architecture and Scar in Myocardial Tissue Using Electrograms: an in-silico study. In **Biomedical Signal Processing and Control**.
6. Wong N, Meshkinfamfard S, Turbé V, Whitaker M, Moshe M, Bardanzellu A, Dai T, **Pignatelli E.**, Barclay W, Darzi A, Elliott P, Ward H, Tanaka R, Cooke G, McKendry R, Atchison C, Bharath A., 2022. Machine learning to support visual auditing of home-based lateral flow immunoassay self-test results for SARS-CoV-2 antibodies. **Communications Medicine. Nature Research**.
7. Lino, M., Cantwell, C., Fotiadis, S., **Pignatelli, E.**, Bharath, A., 2020. Simulating Surface Wave Dynamics with Convolutional Networks. In **NeurIPS workshop on Interpretable Inductive Biases and Physically Structured Learning**.
8. Fotiadis, S., **Pignatelli, E.**, Valencia, M.L., Cantwell, C., Storkey, A., Bharath, A.A., 2020. Comparing recurrent and convolutional neural networks for predicting wave propagation. In **ICLR Workshop on Deep Neural Models and Differential Equations**.

9. Di Rosario, S., Pignatelli, E. and Mirra, G., 2018, May. *An automated design methodology for acoustic shells in outdoor concerts*. In Proceedings of the **EuroNoise** (Vol. 2018, pp. 2123–2130).
10. Pignatelli, E., Mirra, G. and Pone, S., 2017, September. *InFormer: designing forming actions in post-formed gridshells by means of Multi-Objective Genetic Algorithms*. In Proceedings of **IASS Annual Symposia** (Vol. 2017, No. 17, pp. 1–10). International Association for Shell and Spatial Structures (IASS).
11. Pignatelli, E., Mirra, G. and Pone, S., 2016, September. *Computational morphogenesis and construction of an acoustic shell for outdoor chamber music*. In Proceedings of **IASS Annual Symposia** (Vol. 2016, No. 17, pp. 1–10). International Association for Shell and Spatial Structures (IASS).
12. Pone, S., Mirra, G., Pignatelli, E., Lancia, D. and Colabella, S., 2016, October. *Specialised algorithms for different project stages in a post-formed timber gridshell design*. In Proceedings of the 3rd International Conference on Structures and Architecture (**ICSA**) (pp. 259–266).
13. Di Rosario, S., Parenti, B., Pignatelli, E., Mirra, G., Pone, S., 2015, October. *Res, Resonant String Shell, development and design of an acoustic shell for outdoor chamber music concerts*. In Proceedings of the **Institute of Acoustics** (Vol. 37, pp. 354–373). 9th International Conference on Auditorium Acoustics.
14. Pignatelli, E., Colabella, S., Rosario, S.D. and Pone, S., 2015, August. *A wooden acoustic shell for open-air chamber music concert*. In Proceedings of **IASS Annual Symposia** (Vol. 2015, No. 25, pp. 1–12). International Association for Shell and Spatial Structures (IASS).

AWARDS AND SCHOLARSHIPS

1. **UK Research and Innovation Studentship**
Including 4 years funding to spend at the University College London for a PhD in Reinforcement Learning.
2. **Best Innovation 2020 – Society of Digital Engineering**
For the design of the open-source *Buildings and Habitats Object Model* (bhomxyz), to democratise the access to computational engineering.
3. **Peter Lord Award**
Conferred by the Institute of Acoustics to the ReS Team, for the work “*ReS, Resonant String Shell, Development and Design of an Acoustic Shell for Outdoor Chamber Music Concerts*” as “*a project that showcases outstanding and innovative design*”. 2016.
4. **Honorary Fellowship: Authority in the subject (Cultore della Materia)**
In *Technology for Architecture* at the University of Naples Federico II. From 2016 to 2018.
5. **Essence of Buro Happold Award**
Funding, as part of the Computational Team, Team of the Year, which “*has become an inspiration, the heart of exploring something we do not know where it is going to take us but instinctively is the right thing to do.*” P. Rogers, Senior Partner, 2017.
6. **M.A.R Scholarship – <https://www.vpmusica.com/>**
For the design and construction of the award winning prototype defended in the master’s thesis “*Computational Morphogenesis and Construction of an Acoustic Shell for Outdoor Chamber Music*”. 2015.

PRESENTATIONS AND LECTURES

1. **Innochain Symposium, Expanding Information Modelling** Copenhagen, Denmark – November 2018
Presenting: “*The BHoM – A framework for mass adoption of Computational Design*”, Copenhagen, Denmark.
2. **Architectural Association, EmTec, Invited lecture** London, UK – June 2018
Presenting: “*Generative design with active bending*”
3. **Royal College of Art, Invited lecture** London, UK – February 2018
Presenting: “*Algorithmic thinking in design*”
4. **IABSE Symposium** Bath, UK – April 2017
Buro Happold Representatives Talk: “*Generative design of an Acoustic Chamber for Outdoors*”
5. **IASS Symposium 2015** Amsterdam, Netherlands – August 2015
Presenting: “*A wooden acoustic shell for open-air chamber music concert*”.
6. **University of Naples, Invited lecture** Naples, Italy – March 2015
Presenting: “*A strategy for the waterfront of Naples*”, Naples, Italy.

LICENCES

- Registered Architect in the UK at the ARB, with number: 08860D, from Feb 2017.
- White/Yellow CSCS Professionally Qualified Person card, from Feb 2018.

SUPPLEMENTARY COURSES

1. **Deep Learning Specialization**
Licence 55M8BYZZTGL7, Prof. Andrew Ng, Coursera
2. **Neural Networks and Deep Learning – Andrew Ng, Coursera**
Licence WJE8TMPBTAM6, Prof. Andrew Ng, Coursera
3. **Improving Deep Neural Networks: Hyperparameter tuning, Regularization and Optimization**
Licence KTQFX9DLUBS, Prof. Andrew Ng, Coursera
4. **Structuring Machine Learning Projects**
Licence XTFC757KVLH, Prof. Andrew Ng, Coursera
5. **Convolutional Neural Networks**
Licence 8X8Z8NQS5QPB, Prof. Andrew Ng, Coursera
6. **Sequence Models**
Licence PXD3GPJWBWKF, Prof. Andrew Ng, Coursera