

POST-DIGITAL Newsletter

Issue 2

| December 2021

| <https://postdigital.astonphotonics.uk>

This is the second issue of the **POST-DIGITAL Newsletter**, a **European Training Network** funded by the European Commission under Horizon 2020 Marie Skłodowska-Curie ITN Action. The project trains [15 early stage researcher \(ESRs\)](#).

After the successful first year of the project the POST-DIGITAL ESRs focused on their research, outreach and dissemination activities.

This led to a number of papers, participation in conferences and workshops. After more than a year of online meetings and events the POST-DIGITAL ESRs could start their first secondments and meet their colleagues from the project team in person.

Want to know more about POST-DIGITAL? Keep up to date by following us on the social media and checking our [website](#).



This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 860360.

ETHICS ADVISOR

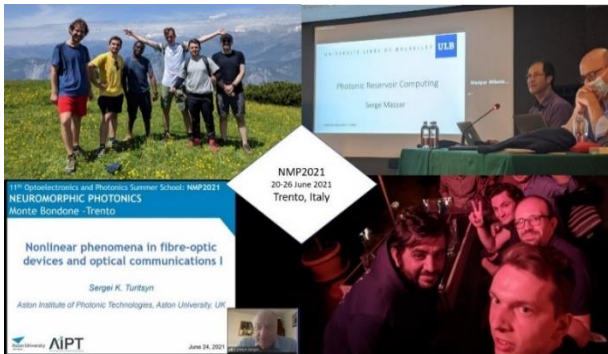
We are happy to announce that Prof Claudia Cevenini has joined the POST-DIGITAL Supervisory Board as Ethics Advisor.



Claudia is adjunct professor of IT and law at the Department of Information Technology - Science and Engineering, Bologna University. She has Ph.D. in Legal Informatics and IT law, Master Degree in Business magna cum laude. Claudia is Innovation expert, Ethics expert, Evaluator, monitor and rapporteur for the European Commission (DG CNECT, DG RTD, REA, ERCEA). As experienced ethics advisor of several EU funded projects Claudia will provide a training on the ethical implications of new and emerging technologies (especially neuromorphic technologies and Artificial Intelligence in general). The first introduction on Ethics in Technology was held online on 15 December 2021.

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On **17 and 18 May 2021** the POST-DIGITAL Consortium held its **Mid-Term Review Meeting** with the EU Project Officer via Zoom. The Consortium received a positive feedback from the Project Officer on the overall project's progress. Great presentations from the POST-DIGITAL researchers demonstrated their excellent qualification, motivation and progress to date. All 15 ESRs have been recruited, all milestones have been successfully achieved, all training events were organized, 5 out of 6 deliverables were submitted to the EC.



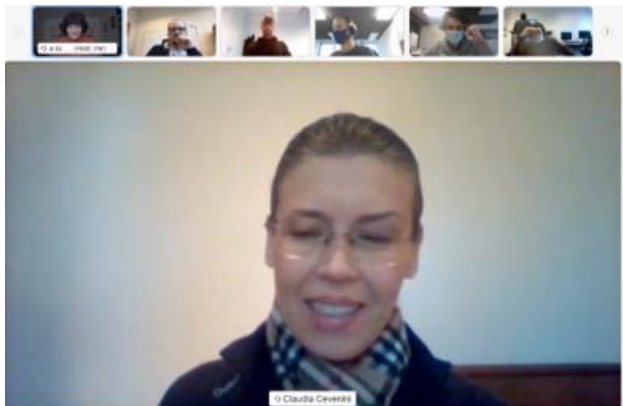
On **20- 26 June 2021** 9 POST-DIGITAL ESRs took part in the **11th Optoelectronics and Photonics School in Trento, Italy**. The event offered the first opportunity for POST-DIGITAL ESRs to meet in person and was a very positive experience for them. Organizers of the event were University of Trento, the Nanoscience laboratory and our beneficiary Institute for Cross-Disciplinary Physics and Complex Systems (IFISC) of the University of the Balearic Islands.

From **15 to 17 September 2021** Université de Franche-Comté, Thales and Université libre de Bruxelles organized the **Summer School “Novel Nonlinear Substrates for Neural Networks”**. It was co-located with a **Tutorial on conceptors** provided by Prof. H. Jaeger from University of Groningen and was held as a hybrid event on the premises of FEMTO-ST in Besancon. The meeting was very constructive and we are pleased to see that the cohesion of the POST-DIGITAL ESRs team is extraordinary.



MAJOR NETWORK-WIDE EVENTS

The second **2nd Annual Photonic Circuit Design Training** was held on **18 and 19 November 2021**. It was a hands-on training organised by VLC Photonics in Valencia. All 15 POST-DIGITAL ESRs took part in the event in person, which was a perfect opportunity for them to socialize, facilitate new discussions and collaborations and consolidate the project network.



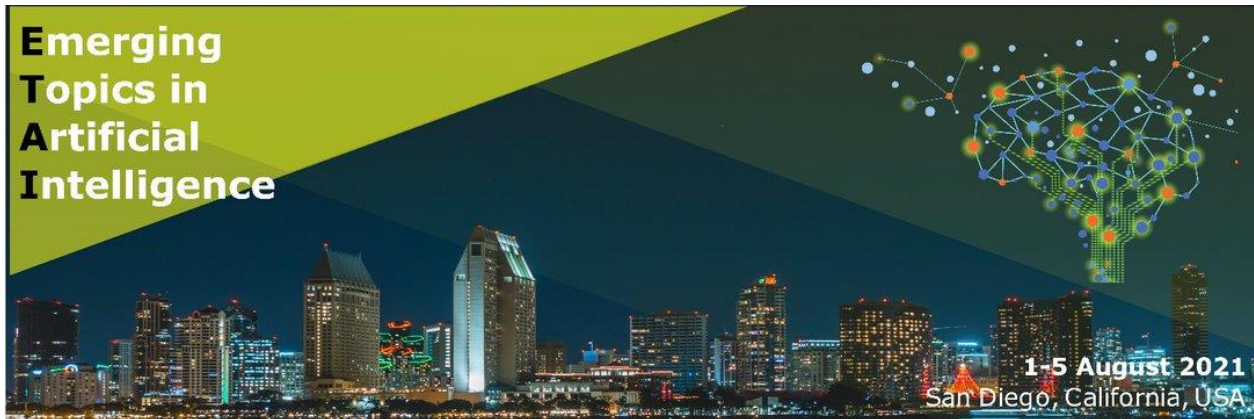
On **15 December 2021** the POST-DIGITAL Ethics Advisor Prof Claudia Cevenini from University of Bologna organized the first introduction on **Ethics in technology** for the POST-DIGITAL ESRs. The training was held online.

UPCOMING NETWORK-WIDE EVENTS

The **Second year POST-DIGITAL workshop** will be held on 26 and 27 January 2022, organized by the POST-DIGITAL beneficiary University of Groningen.

The Mini-Symposium **“Scaling up Systems and Application Complexity in Analog Neuromorphic and Physical Computing”** will be held on 28 January 2021 in Groningen.





Four POST-DIGITAL papers were presented at ETAI 2021 showing the recent results achieved by our teams at UBFC, ULB, Aston and IFISC.

PAPER 1

A complete, parallel, and autonomous photonic neural network in a semiconductor multimode laser
Anas Skalli (ESR3, UBFC), J. Porte, Nasibeh Haghighi, Stephan Reitzenstein, James A. Lott, Daniel Brunner

PAPER 2

Analog information processing with time-multiplexed optoelectronic systems
Mirko Goldmann (ESR5, CSIC), Ingo Fischer, Miguel C. Soriano

PAPER 3

Noise-Resistant Optical Implementation of Analogue Neural Networks
Diego Arguello Ron (ESR7, Aston), Morteza Kamalian-Kopae, Sergei Turitsyn

PAPER 4

Frequency multiplexed optical extreme learning machine
Alessandro Lupo (ESR12, ULB), Lorenz Butschek, Serge Massar



We are delighted that our ESR **Alessandro Lupo** from ULB, Belgium received the Best ESR presentation award sponsored by the POST-DIGITAL beneficiary LightOn!



At the **Conference on Lasers and Electro-Optics/Europe (CLEO Europe)**, held online on 21-25 June 2021 **Diego Arguello Ron (ESR7, Aston)** presented the paper “Noise-Resistant Optical Implementation of Analogue Neural Networks” with authors *Diego Arguello Ron, Morteza Kamalian-Kopae and Sergei Turitsyn.*

At **The International Joint Conference on Neural Networks (IJCNN) 2021**, held online on 18-22 July 2021 **Mirko Goldmann (ESR5, CSIC)** presented the paper “Exploiting transient dynamics of a time-multiplexed reservoir to boost the system performance” with authors *Mirko Goldmann, Claudio R. Mirasso, Ingo Fischer and Miguel C. Soriano.*



At the workshop **Deep Learning in Unconventional Neuromorphic Hardware DLUNH** of the IJCNN 2021 conference, on 23 July 2021 3 POST-DIGITAL ESRs presented their research results:

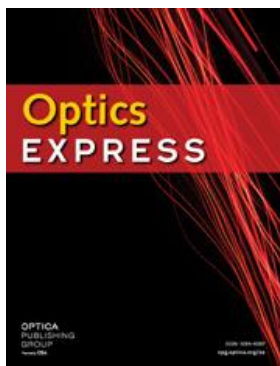
- **Anas Skalli (ESR3, UBFC)** presented the paper “A complete, parallel, and autonomous photonic neural network in a semiconductor multimode laser”, authors *Anas Skalli, Xavier Porte, Nasibeh Haghighi, Stephan Reitzenstein, James Lott, Daniel Brunner.*
- **Diego Arguello Ron (ESR7, Aston)** presented the paper “Noise-Resistant Optical Implementation of Analogue Neural Networks” with authors *Diego Arguello Ron, Morteza Kamalian-Kopae and Sergei Turitsyn.*
- **Mirko Goldmann (ESR5, IFISC)** presented the paper “Memory engineering using a reconfigurable deep reservoir architecture” with authors *Mirko Goldmann, Claudio R. Mirasso, Ingo Fischer, Miguel C. Soriano.*

PAPERS AND CONFERENCE PARTICIPATION



We are very happy that **Anas Skalli** (ESR3, UBFC) received the **Best Student Paper Award** for the paper “Link between physical properties and computational performance in a VCSEL – based artificial neural network”, (*A. Skalli, X. Porte , N. Haghghi, S. Reitzenstein , J. A. Lott and D. Brunner*), which he presented at the **International Symposium on Physics and applications of laser dynamics, 18 Nov 2021.**

Journal Publication:



Photonic extreme learning machine based on frequency multiplexing

Alessandro Lupo, Lorenz Butschek, and Serge Massar

Optics Express Volume . 29, Issue 18, p. 28257-28276 (2021)

DOI: [10.1364/OE.433535](https://doi.org/10.1364/OE.433535)

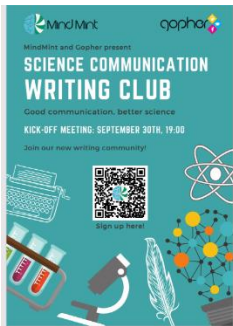
Link to the publication [here](https://doi.org/10.1364/OE.433535)

Abstract

The optical domain is a promising field for the physical implementation of neural networks, due to the speed and parallelism of optics. Extreme learning machines (ELMs) are feed-forward neural networks in which only output weights are trained, while internal connections are randomly selected and left untrained. Here we report on a photonic ELM based on a frequency-multiplexed fiber setup. Multiplication by output weights can be performed either offline on a computer or optically by a programmable spectral filter. We present both numerical simulations and experimental results on classification tasks and a nonlinear channel equalization task.

OUTREACH

On 16 May 2021 several sister projects coordinated by Aston University celebrated the **International Day of Light**. In a special **Research Brochure** created by the Aston team the POST-DIGITAL ESRs **Anas Skalli** (UBFC), **Elger Vlieg** (IBM) and **Long Hoang Nguyen** (Aston) shared exciting insights in their research topics and how their work relates to the concept of «light».

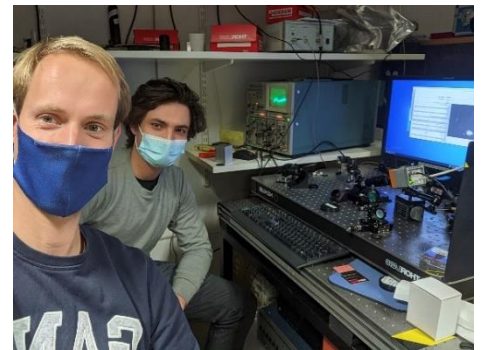


In July 2021 **Steven Abreu**, ESR at the University of Groningen co-founded a writing club for science communication at GOPHER (Groningen Organization for PhD Education and Recreation). The club organizes regular meetings for young researchers to talk about science communication and to write for a general scientific audience, it manages workshops, a buddy writing system, reviewing/editing process and publishing on the club's platform.

On 27 April 2021 **Sarah Masaad** gave introduction on research groups to Master students from UGent and ULB.

SECONDMENTS

Since October 2021 several POST-DIGITAL ESRs started their first secondments: **Lucas Talandier**, ESR at IFISC went on a 3-month secondment at IBM Research in Zurich where he works together with **Elger Vlieg**.



Sarah Masaad (IMEC), **Benedikt Vettelschoss** (UGent), **Anas Skalli** (UBFC) and **Mirko Goldmann** (IFISC) started in November 2021 their secondments at the University of Groningen working with **Steven Abreu** and **Guillaume Pourcel**.

