

# Piotr Antonik, PhD

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## Profile

- **FPGA** programming (Xilinx platforms)
- Design and development of advanced **optical** and opto-electronic **experimental** systems
- Expertise in **artificial neural networks**, **computer vision** and **machine learning**
- Rich **teaching** experience
- **Trilingual** (Russian, French, English)

## Academic degrees

- Ph.D. in Physics, Université libre de Bruxelles, Brussels (Oct. 2013 – Sep. 2017)
- M.S. in Physics (with great honours), Université libre de Bruxelles, Brussels (Sep. 2011 – Sep. 2013)
- B.S. in Physics (with great honours), Université libre de Bruxelles, Brussels (Sep. 2008 – Aug. 2011)

## Research positions

**October 2018 – present:** Associate Professor at CentraleSupélec

- Position : LMOPS EA-4423 Lab & Chair in Photonics, CentraleSupélec & Université de Lorraine, Metz campus, Metz, France
- Research interests : computer vision, FPGA development, optical neuromorphic computing

**October 2017 – October 2018** Postdoctoral position at CentraleSupélec

- Position : LMOPS EA-4423 Lab, CentraleSupélec, Metz campus, Metz, France
- Research interests : optical neuromorphic computing, analogue time-delay reservoir computing, large-scale free-space optical reservoir computing, wide-band opto-electronic oscillators for advanced signal processing

**January – May 2017:** Internship at University of Texas at Austin

- Position : Department of Biomedical Engineering, University of Texas at Austin, Austin, USA
- Topic : Application of artificial neural networks to real-time medical image processing and diagnosis

**October 2013 – September 2017:** PhD Student at Université libre de Bruxelles

- Position : Laboratoire d'Information Quantique & Service OPERA-Photonique, Université libre de Bruxelles, Brussels, Belgium

- Topic : Application of FPGA to real-time machine learning: hardware reservoir computers and software image processing

**September 2012 – May 2013:** Master's Project at Université libre de Bruxelles

- Position : Laboratoire d'Information Quantique & Service OPERA-Photonique, Université libre de Bruxelles, Brussels, Belgium
- Topic : Reservoir computing with delayed-feedback laser

## Publications

I authored and co-authored 2 books, 12 journal papers and 18 conference proceedings (full-length papers and abstracts), and gave 2 invited talks and seminars. See the full list below.

## Teaching

**2021 – 2022:** estim. 250 h at CentraleSupélec (teaching and projects supervision)

**2020 – 2021:** 253 h at CentraleSupélec (teaching modelling, electromagnetism, optimisation, neuromorphic computing; projects supervision)

**2019 – 2020:** 76 h at CentraleSupélec (teaching modelling & electromagnetism)

**2018 – 2019:** 102 h at CentraleSupélec (lab assistant & projects supervision)

**2017 – 2018:** 30 h at CentraleSupélec (projects supervision)

**2016 – 2017:** 68 h at ULB (lab assistant in physics and optics)

**2015 – 2016:** 114 h at ULB (lab assistant in physics, optics and electronics)

**2014 – 2015:** 73 h at ULB (lab assistant in physics and electronics)

## Grants, Fellowships & Awards

- Springer Theses Award (recognising outstanding Ph.D. research, 2018)
- F.R.S.-FNRS Research Grant J.0040.16. Photonic Reservoir Computing (2016 – 2017)
- F.R.S.-FNRS Research Fellow (Oct. 2013 – Sep. 2017)
- Honourable Mention at the 38th International Physics Olympiad, Vietnam, 2008
- Winner of the Belgian Physics Olympiad, 2007

## Activities

- Reviewer for IEEE TNNLS, Neurocomputing, Optics Express and Cognitive Computation journals.

# Full publications list

## Books and book chapters

1. Brunner, Daniel, Miguel C. Soriano, and Guy Van der Sande, eds. “Photonic Reservoir Computing: Optical Recurrent Neural Networks.” *Walter de Gruyter GmbH & Co KG*, 2019.
2. **Antonik, Piotr**. “Application of FPGA to Real-Time Machine Learning: Hardware Reservoir Computers and Software Image Processing.” *Springer*, 2018.

## Journal papers

### 2020

1. **Antonik, Piotr**, Serge Massar, and Guy Van Der Sande. “Photonic reservoir computing using delay dynamical systems.” *Photoniques* 104 (2020): 45-48.
2. Baruah, V., Zahedivash, A., Hoyt, T., McElroy, A., Vela, D., Buja, L.M., Cabe, A., Oglesby, M., Estrada, A., **Antonik, P.** and Milner, T.E., 2020. “Automated Coronary Plaque Characterization With Intravascular Optical Coherence Tomography and Smart-Algorithm Approach: Virtual Histology OCT.” *JACC: Cardiovascular Imaging*, 13(8), pp.1848-1850.
3. Nguimdo, R. M., **Antonik, P.**, Marsal, N., and Rontani, D. (2020). “Impact of optical coherence on the performance of large-scale spatiotemporal photonic reservoir computing systems.” *Optics Express*, 28(19), 27989-28005.
4. **Antonik, Piotr**, et al. “Bayesian optimisation of large-scale photonic reservoir computers.” *Cognitive Computation* (in press).

### 2019

- **Antonik, Piotr**, et al. “Human action recognition with a large-scale brain-inspired photonic computer.” *Nature Machine Intelligence* 1.11 (2019): 530-537.
- **Antonik, Piotr**, Nicolas Marsal, and Damien Rontani. “Large-scale spatiotemporal photonic reservoir computer for image classification.” *IEEE Journal of Selected Topics in Quantum Electronics* 26.1 (2019): 1-12.

### 2018

- **Antonik, Piotr**, et al. “Using a reservoir computer to learn chaotic attractors, with applications to chaos synchronization and cryptography.” *Physical Review E* 98.1 (2018): 012215.
- **Antonik, Piotr**, et al. “Random pattern and frequency generation using a photonic reservoir computer with output feedback.” *Neural Processing Letters* 47.3 (2018): 1041-1054.

### 2017

- **Antonik, Piotr**, Marc Haelterman, and Serge Massar. “Brain-inspired photonic signal processor for generating periodic patterns and emulating chaotic systems.” *Physical Review Applied* 7.5 (2017): 054014.
- **Antonik, Piotr**, Marc Haelterman, and Serge Massar. “Online training for high-performance analogue readout layers in photonic reservoir computers.” *Cognitive Computation* 9.3 (2017): 297-306.

## 2016

- **Antonik, Piotr**, et al. “Online training of an opto-electronic reservoir computer applied to real-time channel equalization.” *IEEE transactions on neural networks and learning systems* 28.11 (2016): 2686-2698.
- Hermans, M., **Antonik, P.**, Haelterman, M., and Massar, S. (2016). “Embodiment of learning in electro-optical signal processors.” *Physical review letters*, 117(12), 128301.

## Invited talks & seminars

### 2021

1. **Antonik, P.** (2021, June). “Machine learning at the speed of light.” DKFZ Data Science Seminar.
2. **Antonik, P.** (2021, September). “Human Action Recognition with Photonic Reservoir Computing.” In *2021 Photonics in Switching and Computing (Optica Virtual Event)*.

## Conference papers

### 2020

1. Rontani, D., **Antonik, P.**, Marsal, N., and Brunner, D. (2020, March). Automatic classification of video using a scalable photonic neuro-inspired architecture. In *Physics and Simulation of Optoelectronic Devices XXVIII* (Vol. 11274, p. 112740F). International Society for Optics and Photonics.

### 2019

1. Héroux, J. B., Kanazawa, N., and **Antonik, P.** (2019, September). “Time Series Processing with VCSEL-Based Reservoir Computer.” In *International Conference on Artificial Neural Networks* (pp. 165-169). Springer, Cham.
2. **Antonik, P.**, Marsal, N., Brunner, D., and Rontani, D. (2019, September). “Comparison of Feature Extraction Techniques for Handwritten Digit Recognition with a Photonic Reservoir Computer.” In *International Conference on Artificial Neural Networks* (pp. 175-179). Springer, Cham.
3. **Antonik, P.**, Marsal, N., Brunner, D., and Rontani, D. (2019, September). “Classification of Human Actions in Videos with a Large-Scale Photonic Reservoir Computer.” In *International Conference on Artificial Neural Networks* (pp. 156-160). Springer, Cham.

### 2018

1. **Antonik, P.**, Gulina, M., Pauwels, J., Rontani, D., Haelterman, M., and Massar, S. (2018, July). “Spying on chaos-based cryptosystems with reservoir computing.” In *2018 International Joint Conference on Neural Networks (IJCNN)* (pp. 1-7). IEEE.
2. **Antonik, P.**, Marsal, N., Brunner, D., and Rontani, D. (2018). “Performance analysis of a large-scale photonic reservoir computer on image classification.” In *NOLTA*.

**2017**

1. Akram Akrouf, **Piotr Antonik**, Marc Haelterman, and Serge Massar. “Towards autonomous photonic reservoir computer based on frequency parallelism of neurons”. In: *Proc. SPIE*. Vol. 10089. 2017, 100890S-100890S-7.
2. **Piotr Antonik**, Michiel Hermans, Marc Haelterman, and Serge Massar. “Photonic Reservoir Computer With Output Feedback for Chaotic Time Series Prediction”. In: *2017 International Joint Conference on Neural Networks*. 2017.
3. **Piotr Antonik**, Marc Haelterman, and Serge Massar. “Improving Performance of Analogue Readout Layers for Photonic Reservoir Computers with Online Learning”. In: *AAAI Conference on Artificial Intelligence*. 2017.
4. **Piotr Antonik**, Michiel Hermans, Marc Haelterman, and Serge Massar. “Chaotic Time Series Prediction Using a Photonic Reservoir Computer with Output Feedback”. In: *AAAI Conference on Artificial Intelligence*. 2017.
5. **Piotr Antonik**, Marc Haelterman, and Serge Massar. “Predicting chaotic time series using a photonic reservoir computer with output feedback”. In: *26th Belgian-Dutch Conference on Machine Learning*. 2017.
6. **Piotr Antonik**, Marc Haelterman, and Serge Massar. “Towards high-performance analogue readout layers for photonic reservoir computers”. In: *26th Belgian-Dutch Conference on Machine Learning*. 2017.

**2016**

1. **Piotr Antonik**, Michiel Hermans, François Duport, Marc Haelterman, and Serge Massar. “Towards pattern generation and chaotic series prediction with photonic reservoir computers”. In: *SPIE’s 2016 Laser Technology and Industrial Laser Conference*. Vol. 9732. 2016, 97320B.
2. **Piotr Antonik**, Michiel Hermans, Marc Haelterman, and Serge Massar. “Towards adjustable signal generation with photonic reservoir computers”. In: *25th International Conference on Artificial Neural Networks*. Vol. 9886. 2016.
3. **Piotr Antonik**, Michiel Hermans, Marc Haelterman, and Serge Massar. “Pattern and frequency generation using an opto-electronic reservoir computer with output feedback”. In: *APNNS’s 23th International Conference on Neural Information Processing*. Vol. 9948. LNCS. 2016, pp. 318-325.

**2015**

1. **Piotr Antonik**, Anteo Smerieri, François Duport, Marc Haelterman, and Serge Massar. “FPGA implementation of reservoir computing with online learning”. In: *24th Belgian-Dutch Conference on Machine Learning*.
2. **Piotr Antonik**, François Duport, Anteo Smerieri, Michiel Hermans, Marc Haelterman, and Serge Massar. “Online training of an opto-electronic reservoir computer”. In: *APNNA’s 22th International Conference on Neural Information Processing*. Vol. 9490. LNCS. 2015, pp. 233-240.
3. **Piotr Antonik**, François Duport, Anteo Smerieri, Michiel Hermans, Marc Haelterman, and Serge Massar. “Improving performance of opto-electronic reservoir computers with online learning”. In: *20th Annual Symposium of the IEEE Photonics Society Benelux Chapter*. 2015.