

# TOON WEYENS

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Passionate about mathematics, science, technology and shaping the future. Trained as a Ph.D. in applied physics, followed by two years of research in nuclear fusion as the energy source of the future at the ITER Organization through the Monaco postdoctoral fellowship. Well-versed in computer science with extensive experience in Fortran, python, HPC parallel computing, git, vim, scientific visualization, among others. Enjoying mathematical excursions in domains such as partial differential equations, statistics, linear algebra, graph theory, neural networks. Very inquisitive and analytical. Currently looking for exciting new challenges in the fields of data science and artificial intelligence. Especially interested in Bayesian Machine Learning, a thoroughly enjoyable union of mathematical rigor and machine learning superpowers.

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Nationality: Belgian  
Date of birth: 30/12/1987

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## EXPERIENCE

Jan '17 - Current **Postdoctoral Monaco Fellow**

*ITER Organization*

- Responsible for investigation of 3-D effects on Edge-Localized Modes (ELM) stability
- Located at multi-billion dollar ITER project, world's most advanced nuclear fusion research reactor
- Using numerical code PB3D, developed as part of my Ph.D. project (see below)

Jan '12 - Dec '16 **Doctoral Researcher**

*Universidad Carlos III de Madrid · Eindhoven University of Technology · ITER Organization*

- Designed research project to improve understanding of *high-n* instabilities
  - Important class of instabilities in toroidal magnetic confinement devices for nuclear fusion
  - Developed dedicated mathematical theory [Weyens et al, 2014, P.o.P, 21, 4]
  - Designed optimized numerical code, PB3D [Weyens et al, 2017, J.c.P, 330]
  - Used modern Fortran, High-Performance Parallel Computing (HPC) techniques
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## EDUCATION

Sep '10 - Aug '12 **Master of Science - Nuclear Fusion Science & Technology**

*Ghent University · Universidad Carlos III de Madrid · Université de Lorraine*

- European program in the Erasmus Mundus framework.

- Fusion Engineering & Fusion Science
- Focus on (European) culture and language

Graduated top 5%.

Sep '08 - Aug '10 **Master of Science - Energy Engineering**

*University of Leuven · Technische Universität Berlin (exchange)*

- Multidisciplinary curriculum
- Strong ties to industry
- (Thermo-)Mechanical & Electrical engineering
- Focus on economical aspects of energy
- Personal experience: exchange in TU Berlin for first half curriculum

Graduated top 15%.

October '18 **Online Course - Bayesian Methods for Machine Learning** (part of Advanced Machine Learning)

*Coursera advanced, by Higher School of Economics Moscow*

- Expectation-Maximization (EM) algorithm
- Variational Inference & Latent Dirichlet Allocation
- Markov chain Monte Carlo
- Variational Autoencoder
- Gaussian processes & Bayesian optimization
- PyMC3, GPy, GPyOpt

Graduated with honors.

certificate: [link](#)

May '18 **Online Specialization - Deep Learning**

*Coursera intermediate, by Andrew Ng*

- Deep learning foundations by master educator Andrew Ng
- Convolutional neural networks
- Sequence models: RNN, (Bi)LSTM, GRU
- Optimizers: Stochastic, Adam, AdaMax
- Overfitting: dropout, BatchNorm
- TensorFlow & Keras

certificate: [link](#)

May '14 **Summer School - 23rd Summer School on Parallel Computing**

*CINECA, Casalecchio Di Reno*

- 10 day intense graduate HPC course
- Modern parallel computing systems for computation
- HPC introduction, parallel architectures, MPI & OpenMP
- Profilers & debuggers

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## PROJECTS

Jan '13 - Current **PB3D**

**Peeling-Ballooning in 3-D**

- Part of my doctoral research project.

- Capable of efficiently analyzing peeling-ballooning stability of toroidal magnetic confinement devices
- Crucial for nuclear fusion
- Freely available and well-documented

*for experts:*

- Mathematical minimization of functional, leading to generalized eigenvalue equation
- *high-n* instabilities easily excited, couple plasma (150 million °C) to the cold reactor walls (-260.8 °C)
- General 3-D configurations, perturbed plasma edge [Weyens et al, 2017, J.c.P, 330]
- Postdoctoral research: investigate 3-D effects
  - resonant magnetic perturbations for ELM control (RMP)
  - toroidal field coil (TF) ripple

website: [PB3D.github.io](https://PB3D.github.io)

source: [github](#)

Feb '18 - Current **Pylgrim**

*Elementary Shortest Path Problem with or without Resource Constraint*

- Python implementation of promising algorithms for Elementary Shortest Path Problem (ESPP)
- From recent publications, to benchmark and learn - currently:
  - [Di Puglia Pugliese et al, 2016, Comput Optim Appl, 63]
  - [Boland et al, 2006, Oper Res Lett].
- problem is NP-hard, so efficient solution is interesting mathematical and computational problem

website: [github](#)

Jan '18 - Current **Kraemer**

*High-frequency crypto automated arbitrage trader*

- Co-creator.
- Collaborative project drawing from variety of expertises
- Based on computational sciences & mathematical and physical knowledge
- Supported by state of the art cryptocurrency financial modelling & deep learning strategies

Oct '18

**Facial Composites: Finding the Suspect**

*Capstone project for Bayesian Methods for Machine Learning*

- Helps you with getting face of suspect in crime
- Employed variational autoencoder in Keras and Tensorflow to generate face images
- Combined with Gaussian Process Optimization through GpyOpt
- Interacts with you through simple binary *yes/no* questions
- Optimized program to require minimal amount of interaction

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## SKILLS

Languages

English



Dutch



Spanish



French ★★★★★  
German ★★★★★  
Portuguese ★★★★★  
Italian ★★★★★

## Computer

- **Linux** · daily and much-preferred operating system
- **vim** · daily and much-preferred editor
- **LaTeX** · preferred tool for documents
- **html, CSS** · used for this curriculum vitae (with markdown → Pandoc)
- **git** · for version control of virtually all my documents and projects
- **ParaView, VisIt** · favorite 3-D visualization tools, combined with HDF5 and XDMF
- **HDF5 with XDMF** · best data model, both for storage and for visualization

## Programming

- **Fortran** · HPC application such as PB3D
- **Python** · numpy, scipy, pandas, cython, aioproccessing, ...
- **Matlab** · Daily scripting but also larger applications
- **C++** · especially useful paired with the BOOST library
- **TensorFlow, Keras** · Deep Learning quick modelling
- **PyMC3, GPy, GPyOpt** · Bayesian Machine Learning
- **MPI, OpenMP** · parallelization for HPC
- **jupyter notebooks** · exploratory programming
- **Bash, Make, ...** · daily scripting and development
- **MySQL** · simple database
- **LaTeX, LuaTeX** · large documents, such as Ph.D. dissertation

## Other

- **Fusion DC** 2016 Program Representative
- **TGD Solutions** board member

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## AWARDS

2017

### Ph.D. Research Award

*European Physical Society*

The Award The Plasma Physics Division of the European Physical Society (EPS) shall grant up to four prizes annually to young scientists from the 38 European countries associated with the EPS in recognition of truly outstanding research achievements associated with their PhD study in the broad field of plasma physics.

website: EPS

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