

# Thibaut Cuvelier

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## Operational research in industrial applications

*Research keywords: mathematical optimisation, network routing, data analytics*

## Education

2013 – 2015: **Master in Computer Science and Engineering**, university of Liège, magna cum laude (second year: summa cum laude; master's thesis: summa cum laude).

*Master's thesis: Implementing and comparing stochastic and robust programming.*

Two paradigms are often used in the optimisation literature in order to model uncertainty: **stochastic and robust programming**. However, they have seen very little **comparison**, which is the goal of this master's thesis. This work considers facility location and unit commitment. I have implemented both paradigms for each problem and conducted an **in-depth study** of the impact on the objective function and on the **robustness** of the obtained solutions.

*Under the supervision of Prof. Q. Louveaux.*

<http://hdl.handle.net/2268/197090>

**Award: best master's thesis in computer science and engineering, AIM.**

*Topics:* applied mathematics (discrete and numerical optimisation, machine learning, high-performance scientific computing), networks (advanced networking, information and coding theory, telecommunications), intelligent robotics.

First aid training (BEPS, Belgian Red Cross), 2015.

2010 – 2013: **Bachelor of Engineering Sciences**, university of Liège.

*Topics:* computer science, electronics.

2004 – 2010: secondary education at Saint-Barthélemy, Liège, magna cum laude.

*Electives:* mathematics, Latin, ancient Greek.

Finalist for the Belgian round of the **Olympics of Informatics** (2010).

## Online courses

- Deep learning specialisation, Andrew Ng, Coursera, March 2018 (overall score: 100%)  
<https://www.coursera.org/account/accomplishments/specialization/SVP835XDYLHA>

## Research experience

Since October 2017: **doctoral researcher** at Orange Labs and CentraleSupélec

*Keywords: mathematical optimisation, network routing, machine learning, bandit algorithms.*

Machine-learning algorithms are often based on optimisation techniques, but do not always take the most of them. For example, combinatorial bandit algorithms tend to have exponential complexity, even with polynomial-time combinatorial problems (matching, shortest path, etc.): with better understanding of optimisation, **I reduce this complexity to polynomial** in many useful cases.

Conversely, machine learning can bring significant advance in optimisation, such as to have a better choice of columns to generate in decomposition schemes or to choose the best algorithm to solve a given instance of a complex problem. To this end, I am working on **oblivious routing**, a static traffic-engineering approach, to which I plan to provide machine-learning-based enhancements.

*Trainings:* 2018 school on column generation (Prof. Guy Desaulniers, Prof. Jacques Desrosiers, Prof. Marco Lübbecke, Prof. Roberto Wolfler-Calvo), TMA 2018 PhD school (Franck Brockners, Joseph Allemandou, Prof. Idilio Drago), TMA 2019 PhD school (Dr. Sara Dickinson, Prof. Narseo Vallina-Rodriguez, Dr. Mirja Kühlewind, Tim Bruijnzeels, Martin Hoffmann), ECML PKDD 2019 Summer School, quality-of-experience track (Prof. Frank Hutter, Dr. Grégoire Montavon, Dr. Florian Lemmerich, Dr. Nico Piatkowski, Dr. Vlad Hosu, Dr. Raimund Schatz, Matti Strese, Prof. Lea Skorin-Kapov), 1st International Summer School on Artificial Intelligence and Games (Prof. Georgios Yannakakis and Prof. Julian Togelius), law and intellectual property (Karim Tadrict), European projects Horizon 2020 (Magali Mares), ethics and technology (Dr Thomas Baudel, Pr. Christine Froidevaux).

Workplace first aider (UNASS, December 2018).

*Expected graduation date:* October 2020.

*Under the supervision of Zwi Altman, Éric Gourdin (Orange Labs) and Richard Combes (CentraleSupélec).*

January 2016-September 2017: **research engineer** at the University of Liège, working on the InduStore project (<http://www.industore-project.be/>).

*Keywords:* *mathematical optimisation, data analytics.*

Industry may take advantage of the **increasing electricity price volatility**, by organising its production around price forecasts, and provide flexibility services to the grid. Moreover, respecting the well-being of the workforce is a requirement in this context, albeit often disregarded. My responsibilities were to develop, apply, and evaluate mathematical **optimisation models** of plant operations, including HR concerns. The result of this work is available as open-source software: <https://github.com/dourouc05/IndustrialProcessFlexibilisation.jl>

*Trainings:* IPCO 2016 summer school (Prof. Michel Goemans, Dr. Nicolas Stier, Prof. Juan Pablo Vielma), algorithmic convex optimisation course (Prof. François Glineur and Prof. Yurii Nesterov).

*Project in partnership with N-SIDE (project coordinator), UCL (ICTEAM and CRECIS), and ICEDD.*

July-August 2014: **internship** at N-SIDE (Louvain-la-Neuve, Belgium), on the ENERTOP project.

*Keywords:* *mathematical optimisation.*

The context is the **optimisation of electricity production** in a complex plant in order to minimise the total energy costs, mostly using cogeneration, using a mathematical optimisation model. My **responsibilities** were to investigate specific issues to make the solutions more **robust to uncertain events**, such as failures, and to analyse

different ways of handling the electricity price uncertainty inside the model. Most of my source code has been deployed in production at the end of my internship.

*Under the supervision of Prof. Bertrand Cornélusse (N-SIDE, now ULg).*

## Communication experience

### Journal articles

- *Comparison Between Robust and Stochastic Optimisation for Long-term Reservoir Operations Under Uncertainty.*  
T. Cuvelier, A. Archambeau, B. Dewals, Q. Louveaux  
Water Resources Management, vol. 32, no. 5, pp. 1599–1614, March 2018  
<http://hdl.handle.net/2268/219394>

### Conference articles

- *ADAM & RAL: Adaptive Memory Learning and Reinforcement Active Learning for Network Monitoring.*  
Sarah Wassermann, Thibaut Cuvelier, Pedro Casas, Pavol Mulinka.  
15th International Conference on Network and Service Management (CNSM) 2019, Halifax (Canada), October 2019.  
<https://hal.archives-ouvertes.fr/hal-02301393>

### Workshop articles

- *RAL: Improving Stream-Based Active Learning by Reinforcement Learning.*  
Sarah Wassermann, Thibaut Cuvelier, Pedro Casas.  
European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases (ECML-PKDD) Workshop on Interactive Adaptive Learning (IAL), Würzburg (Germany), September 2019.  
<https://hal.archives-ouvertes.fr/hal-02265426/>
- *NETPerfTrace — Predicting Internet Path Dynamics and Performance with Machine Learning.*  
Sarah Wassermann, Pedro Casas, Thibaut Cuvelier, Benoît Donnet.  
ACM SIGCOMM Workshop on Big Data Analytics and Machine Learning for Data Communication (Big-DAMA), Los Angeles (USA), August 2017.  
<http://hdl.handle.net/2268/211667>

### Abstracts

- *Improving Stream-Based Active Learning with Reinforcement Learning.*  
Sarah Wassermann, Thibaut Cuvelier, Pedro Casas.  
Workshop for Women in Machine Learning (WiML) 2019.
- *Operation rules of the Vesdre reservoir revisited.*  
Benjamin Dewals, Thibaut Cuvelier, Pierre Archambeau, Sébastien Erpicum, Michel Piroton, Quentin Louveaux.  
6th International Symposium on Hydrological Modelling of the Meuse basin, September 2019.  
<http://hdl.handle.net/2268/239415>
- *Comparing Oblivious and Robust Routing Approaches.*  
Thibaut Cuvelier and Éric Gourdin.  
Programme Gaspard Monge pour l'optimisation, la recherche opérationnelle et leurs interactions avec les sciences des données (PGMO Days) 2018, November 2018.  
<http://hdl.handle.net/2268/229784>

- *Retour d'expérience sur Julia pour la recherche et l'enseignement en recherche opérationnelle.*  
Thibaut Cuvelier.  
Congrès de la Société française de recherche opérationnelle et d'aide à la décision (ROADEF) 2018, February 2018.  
<http://hdl.handle.net/2268/220267>
- *Optimising workforce and energy costs by exploiting production flexibility.*  
Thibaut Cuvelier and Quentin Louveaux.  
21st Conference of the International Federation of Operational Research Societies (IFORS), Québec (Canada), July 2017.  
<http://hdl.handle.net/2268/207330>
- *Modelling the industrial flexibility from the electricity consumption and HR points of view.*  
Thibaut Cuvelier and Quentin Louveaux.  
22nd Belgian Mathematical Optimization Workshop, COMEX (combinatorial optimisation: metaheuristics and exact methods), La Roche-en-Ardenne (Belgium), April 2017.  
<http://hdl.handle.net/2268/209469>
- *Optimisation and uncertainty: comparing stochastic and robust programming.*  
Thibaut Cuvelier.  
30th Annual Conference of the Belgian Operational Research Society (ORBEL), Louvain-la-Neuve (Belgium), January 2016.  
<http://hdl.handle.net/2268/197081>

## Posters

- *Oblivious Routing: Static Routing Prepared Against Network Traffic and Link Failures.*  
Thibaut Cuvelier and Éric Gourdin.  
Network Traffic Measurement and Analysis (TMA) PhD School 2019, Paris (France), June 2019  
<https://hal.archives-ouvertes.fr/hal-02161708/>
- *Oblivious Routing: Worst-Case Routing is not Breaking the Internet's Legs.*  
Thibaut Cuvelier.  
Network Traffic Measurement and Analysis (TMA) PhD School 2018, Vienna (Austria), June 2018.  
<http://hdl.handle.net/2268/227128>
- *Characterising Industrial Sites' Flexibility with Reservoir Models.*  
Thibaut Cuvelier.  
DS3 Data Science Summer School (École Polytechnique), Paris (France), August 2017.  
<http://hdl.handle.net/2268/212703>

## Books

- *Créer des applications graphiques en Python avec PyQt5*, published by D-BookeR, March 2017.  
Thibaut Cuvelier, Pierre Denis.  
ISBN-13: 978-2-8227-0518-9.
- *Créer des applications avec Qt 5 – les essentiels*, published by D-BookeR, November 2013.  
Guillaume Belz, Thibaut Cuvelier, Ilya Diallo, Louis du Verdier, Vincent Meyer, Florent Renault.  
ISBN-13: 978-2-8227-0108-2.
- *Web sémantique : méthodes et outils pour le Web de données*, published by Pearson, May 2012.  
Translated by Thibaut Cuvelier, Julien Plu, Antoine Seilles.  
Original title: *Linked Data: Evolving the Web into a Global Data Space*  
Tom Heath and Christian Bizer.  
ISBN-13: 978-2-7440-2519-8.

## Talks

- *Voyage incertain : découvrir l'optimisation stochastique et robuste*, February 2018, Orange Labs (internal), Châtillon (France)  
<http://hdl.handle.net/2268/219824>
- *A Journey through Julia*, May 2017, IEEE Student Branch Liège (Belgium)  
<http://hdl.handle.net/2268/210211>
- *A Journey through Julia*, November 2016, Geeks anonymes, Liège (Belgium)  
<http://hdl.handle.net/2268/203491>

## Open-source contributions

- Regular contributor to several optimisation-oriented Julia packages: [JuMP.jl](#), [MathOptInterface.jl](#), [MathOptFormat.jl](#), [CPLEX.jl](#), [Gurobi.jl](#), [SCS.jl](#), [Xpress.jl](#)
- Occasional contributor to several Julia packages: [Distributions.jl](#), [Hungarian.jl](#), [LightGraphsMatching.jl](#), [Nemo.jl](#), [SimpleWeightedGraphs.jl](#), [TimeSeries.jl](#)
- Occasional contributor to [Apache POI](#) (Java) and to [Qt](#) (C++)
- Contribution to the translation into French of [Qt Creator](#)
- Occasional contributor to PHP libraries: [GeSHi](#), [Silex](#), [winzouCacheBundle](#)

## Service to the community

Session co-chair at IFORS 2017.

Reviewer for the WiOpt 2018 and JuliaCon 2019 conferences.

Reviewer for the Journal of Hydrology in June and September 2019 and for the Journal of Water Resources Management in September 2019.

## Work experience

- August 2015: development of a real-time car-sharing prototype application for the **ULg**.  
Technologies: Python, Django.  
*Under the supervision of Prof. Bertrand Cornélusse (ULg).*
- July 2015: translation into English of a numerical analysis textbook (2nd year students).
- 2011–2017: officer for the ULg **IEEE Student Branch**. Event organisation, website maintenance, poster design.
- 2009–now: section manager for **Developpez.com**. Team management, website maintenance, application development.
- 2008–now: author, translator, proofreader, and technical book critic for **Developpez.com**. Communication, popularisation. <http://tcuvelier.developpez.com/>

## Pedagogical experience

- Spring 2019: exercise sessions for the **combinatorial optimisation** course (master's students), in French. University of Paris-Sud.  
*Lecturer: Prof. Abdel Lisser.*
- Winter 2018: instructor for the introduction to **object-oriented programming and Java** (bachelor's students), in French. University of Paris-Sud.  
*Lecturer: Prof. Guillaume Wisniewski.*

exercise sessions for the introduction to **probabilities** course (bachelor's students), in French. University of Paris-Sud.

*Lecturer: Prof. Abdel Lisser.*

Spring 2017: project supervision for the **intelligent robotics** course (master's students), with contributions to an open syllabus (TRS: <https://github.com/ULgRobotics/trs>), in English. University of Liège.

*Lecturers: Prof. Bernard Boigelot, Philippe Latour, Antoine Lejeune, Dr. Raphaël Marée, Prof. Marc Van Droogenbroeck, Prof. Louis Wehenkel.*

Winter 2016: exercise sessions and project supervision for the **discrete optimisation** course (master's students), with the design of a complete exercise book, in English. University of Liège.

*Lecturer: Prof. Quentin Louveaux.*

Spring 2016: project supervision for the **intelligent robotics** course (master's students), in English.

*Lecturer: Dr. Renaud Detry.*

Winter 2016: exercise sessions and project supervision for the **discrete optimisation** course (master's students), in English. University of Liège.

*Lecturer: Prof. Quentin Louveaux.*

Spring 2015: student instructor for the **numerical analysis project** (1st year students), in French. University of Liège.

*Lecturer: Prof. Quentin Louveaux.*

## Open course material

**Discrete optimisation:** development of an exercise book with solutions and source code examples, available at <https://github.com/dourouc05/OptimisationTeachingKit>.

**Intelligent robotics:** contributions to TRS (<https://github.com/ULgRobotics/trs>), including updates of the webpages and video making.

## Formal training

Several courses at the *Institut de Formation et de Recherche en Enseignement Supérieur* (IFRES, ULg):

- Design multimedia material for face-to-face teaching
- Competency-based approach
- Motivate my students
- Introduction to evaluation: principles and quality criteria
- Customising teaching by considering students' characteristics
- Triple concordance between objectives, methods, and evaluation
- Organising practical lessons in science and applied science courses
- Introduction to the Blackboard Learn platform
- Using Blackboard Learn to create tests
- Evaluate and regulate one's teaching activities

## Language skills

<b>French</b>	Mother tongue
<b>English</b>	Cambridge FCE (B2 level) in 2010. Full-English master
<b>German</b>	B1-level training from 2014 to 2017

## IT skills

### Programming

<b>Programming languages</b>	Julia, Python, C++, Scala, Java, PHP, C
<b>Data analytics</b>	scikit-learn
<b>Mathematical modelling</b>	JuMP (Julia), AMPL
<b>Optimisation solvers</b>	Gurobi, CPLEX (MILP); Couenne (global nonlinear)
<b>Query languages</b>	SQL, SPARQL
<b>XML technologies</b>	XSLT, XPath, RELAX NG
<b>Development environments</b>	Visual Studio Code (Julia), PyCharm (Python), Mathematica, MATLAB, IntelliJ IDEA (Java), CLion (C++)
<b>Graphical user interfaces</b>	Qt 5 (especially Qt Quick), PyQt

### Office software

<b>Office</b>	Microsoft Word, Microsoft Excel, LyX (LaTeX)
<b>Technical documentation</b>	oXygen XML Author, DocBook
<b>Drawing</b>	Microsoft Visio, Adobe Photoshop

## Personality

Detail-minded, results-driven, autonomous, energised by challenges.

*Sports:* climbing (since 2002, both indoor and outdoor, including competitions), walking.

*Hobbies:* reading novels (thrillers); listening to music (progressive rock, electronica); active contribution to the *Revue des Ingénieurs* at the ULg (satiric play; 2013, 2016).