

# DOCTEUR INGÉNIEUR CIVIL

specialized in Mathematical Programming (identification, classification, optimization & control)



## Personal Data

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## Education

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June 2004

➤ **Ph. D. in the field of mathematical engineering with a specialization in continuous optimization** at the faculty of polytechnics at the University of Brussels (ULB - Université Libre de Bruxelles), Belgium (obtained with the highest distinction)

Thesis : CONDOR: a constrained, non-linear, derivative-free parallel optimizer for continuous, high computing load, noisy objective functions.

June 2003

➤ degree of "**Diplôme d'Étude Approfondie (DEA) en Sciences Appliquées**" at the faculty of polytechnics at the University of Brussels (ULB - Université Libre de Bruxelles), Belgium

Final year project : I realized an unconstrained **optimizer** for continuous, high computing-load, objective function when the derivatives are not available.

June 1999

➤ degree of "**Ingénieur civil**" specialised in computer science at the faculty of polytechnics at the University of Brussels (ULB).

Final year project: I realized a multi-input multi-output fuzzy direct auto-adaptative controller with multiple step ahead prediction (**MSDAFC**). This controller was used for the FAMIMO european research project.

June 1992

➤ Secondary studies, Athénée Royal Ath, Belgium

# Work experiences

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July 2007 -  
November 2007

➤ **Consultant at Business&Decision Belgium**

I was working as expert dataminer and statistician at Business&Decision Belgium.

August 2005-  
May 2007

➤ **Research engineer in the Analysis of Large Social Networks**

I am currently working for the VADIS company to develop a software that analyses large **social networks** based on mobile phone communication logs. The analysis includes **segmentation in clusters** and node ranking inside the clusters. The softwares are based on **I/O efficient external memory** algorithms to be able to process large networks(2000 GB). The objective is to extract from the network some indexes that could be use for marketing/profiling purposes.

April 2005-  
July 2005

➤ **Research engineer in robust optimal control of batch processes**

I worked for the IPCOS company to realize a software that computes the optimal set of parameters of a **hybrid PID controller** (including terms for feedback, feedforward and filtering) for a strongly **non-linear process**. The parameters are computed taking into account the full non-linearity of the batch process along the setpoint trajectory. **No linearity assumption** is made at any point. The final result is higher precision in the solution parameters. The parameters are computed using a special version of my optimizer (**CONDOR**) that is able to work with **non-differentiable non-linear constraints**. The constraints include different kind of stability margins (**mixed  $L_2 / H_\infty$  control**). On a first industrial computer benchmark (produced by **UCB**), CONDOR found an optimal set of parameters that reduces the tracking error to 0.1% of the currently implemented industrial solution while maintaining the same stability margins.

September 2004-  
March 2005

➤ **Research engineer in KDD (Knowledge Discovery in Databases)**

I worked for the WegenerDM/VADIS company. I realized a **datamining/profiling application** able to process vast amount of data (several Gigabytes) in a few minutes. The typical size of the tables that are analyzed is more than  **$10^8$  lines and  $10^5$  columns**. This tools is now used everyday to develop large **direct marketing campaigns** for a number of prestigious companies (Citibank, Procter&Gamble, YvesRocher,...). This tool has been compared with other **large scale statistical analysis packages** (SAS, KXEN, NORKOM, SPSS) and gives higher quality results thanks to results thanks to advanced coding and advanced mathematics. The computation time of this tool is a fraction (1/1000) of the computation time of other solutions.

June 2004-  
August 2004

➤ **Research engineer in optimization of Dry Seals Designs**

I worked shortly at the Computational Department of the **BURGMANN Industries** in Wolfratshausen, **Germany**. Burgmann produces currently nearly all high-technology seals in the **international market**. The **european community** wants to change this situation and open the seal market place to other companies. One way of reaching this goal is to publish a set of "standard

seals designs" that can be used in a vast amount of applications. Once these designs are defined, many industries will be able to compete for the production of the seals. The final result is the opening of the seal market. The technical specifications of these "standard seals" must be carefully chosen because they will be used by **all manufacturers in Europe**. The optimal specifications of the "standard seals" were computed using my optimizer, **CONDOR**. The seal optimization process involves an objective function based on a seal simulation. This simulation includes thermodynamic and plastic deformations of the seal combined with the fluid dynamics simulation of the gas in the leakage. The **objective function is thus highly non-linear, high-computing-load and undefined** on many points of the input space.

2000-2004 ➤ **Research engineer in optimization algorithms for continuous functions.**

I worked on the **METHOD LTR European project** with the university of Florence . The goal of this project is to optimise the shape of turbo-machines. We run a simulation of the gas flow inside the turbine. Based on this simulation, we compute the quality of the shape. We iterate on different shapes until we find the best shape. My job was to write the **optimisation code** that chooses what's the next shape to try. I use **trust region method optimization on multivariate Lagrange interpolator** techniques. The final result is my optimizer, **CONDOR**.

1999-2000 ➤ **Research engineer in Fuzzy control (non-linear identification & datamining)**

I worked at the development of the **FAMIMO ESPRIT LTR European project** in collaboration with other European universities and SIEMENS Automotive. The research activities focus on two different areas. The development of new approaches in the area of **fuzzy identification and control** , and the implementation of a Matlab toolbox that will integrate all the techniques developed by the partners taking part in the project (see <http://iridia.ulb.ac.be/~famimo/>).

1999-2000 ➤ **Research engineer in Real-Time image classification (datamining)**

I worked on the GLAVERBEL project: a **real-time classifier** for the classification of glass defects (world première). This classifier is implemented as a modified TFTP server. It receives images from the **TCP/IP network**, computes the class, sends back the results to an Oracle Database and to the factory computer. Then, the factory computer decides how to cut the glass (commercial optimisation). The percentage of good classification is 94%.

December 1999 ➤ **Development of a pre-press application for the publishing industry.**

I created a large java application called "**Advertedge**". This software processes postscript and PDF files to include gray marks on the edges of the pages. The final objective is to obtain a drawing on three sides of the book when it is closed. This application is currently used **all over the world** in the biggest printing factory (casterman, donelley,...).

June 1999 ➤ **Development of a time series prediction tool (datamining)**

This tool is currently used by D'IETEREN, one of the biggest Belgian car reseller for sales prediction. This tool is based on **Lazy Learning** techniques.

- 1999-2003      ➤ I was involved in the **teaching activities** of the IRIDIA laboratory. I gave laboratories of C++ and java in the faculty of engineering. I also gave **advanced java formation** for enterprises (see [www.technofutur3.be](http://www.technofutur3.be)).

## Papers & Book Chapter

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Please note that a large part of my research results is currently owned by private companies and are subject to patents and copyright protection. Only the free-of-rights research results are described below (and only those that have been published).

- Frank Vanden Berghen, [CONDOR, a parallel, direct, constrained optimizer for high-computing-load, black box objective functions](#) Proceedings of the "Third *MIT* conference on Computational Fluid and Solid Mechanics", Elsevier, june 14-17, 2005.
- Frank Vanden Berghen, [CONDOR: a constrained, non-linear, derivative-free parallel optimizer for continuous, high computing load, noisy objective functions](#). PhD Thesis, University of Brussels (ULB - Université Libre de Bruxelles), June 2004, Belgium
- Frank Vanden Berghen, Hugues Bersini [CONDOR, a new parallel, constrained extension of Powell's UOBYQA algorithm: Experimental results and comparison with the DFO algorithm](#) Journal of Computational and Applied Mathematics, Elsevier, Volume 181, Issue 1, 1 September 2005, Pages 157-175 (also available electronically on the Sciences Direct website)
- Hussain Aziz Saleh, Frank Vanden Berghen [Human genome behaviour: a powerful mechanism for optimizing the use of space technology in surveying networks design](#) GPS Solutions, Springer-Verlag GmbH, Volume 9, Number 3, September 2005, Pages: 201 – 211
- Frank Vanden Berghen [Design et implémentation d'un nouvel algorithme d'optimisation continue non-linéaire dans le cas sans contrainte](#) Specialisation Research Project presented to obtain the Diploma of Deeper Study in Applied Sciences (DEA), University of Brussels (ULB - Université Libre de Bruxelles), June 2003, Belgium
- Simone Pazzi, Francesco Martelli, Vittorio Michelassi, Marco Giachi, Frank Vanden Berghen, Hugues Bersini, [Intelligent Performance CFD optimization of a centrifugal impeller](#) accepted to the Fifth European Conference on Turbomachinery, March 2003, Prague (CZ).
- Frank Vanden Berghen [A tutorial on Q-learning algorithms](#) internal IRIDIA technical report
- Frank Vanden Berghen Hugues Bersini, [Régulation directe adaptative et predictive sur plusieurs pas de temps pour processus à plusieurs entrées et plusieurs sorties](#) chapter of a book entitled « Commande Floue I - de la stabilisation à la supervision » published by Hermes-Science -Lavoisier edition

➤ Frank Vanden Berghen, Edy Bertolissi, Antoine Duchâteau, Hugues Bersini, [Direct Adaptive Fuzzy Control for MIMO Processes](#), Accepted to the FUZZ-IEEE 2000 conference, San Antonio, Texas, 7-10 May, 2000

➤ Frank Vanden Berghen, Edy Bertolissi, Antoine Duchâteau, Hugues Bersini [Régulation directe adaptative et prédictive sur plusieurs pas de temps pour la commande floue de processus à plusieurs entrées et plusieurs sorties](#), internal IRIDIA technical report

➤ Frank Vanden Berghen [Développement d'un régulateur flou à plusieurs entrées et plusieurs sorties adaptatif et prédictif sur plusieurs unités de temps-Utilisation et évaluation des performances de ce régulateur](#) Final Research Project presented to obtain the degree of "ingénieur civil" specialised in computer science.

## Talks in conferences

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July 18-22, 2005      ➤ **22nd IFIP TC 7 Conference on System Modeling and Optimization (Turin, Italy)**

I gave a presentation on the CONDOR optimizer: the algorithmic details and the numerical results.

June 14-17, 2005      ➤ **Third MIT international Conference on Computational Fluid and Solid Mechanics (Massachusetts Institute of Technology, Cambridge, USA)**

I gave a presentation on the CONDOR optimizer: the algorithmic details and the numerical results.

May 29-30, 2000      ➤ **International BELGIUM/FUZZY 2 conference (Faculté des Sciences Appliquées, Mons, Belgium)**

I have presented some results that we obtained at IRIDIA while we were working on the **FAMIMO ESPRIT LTR European project**.

## Awards

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July 2005      ➤ "Young fellowship Award for **exemplary research** in Computation Mechanic" from the **MIT (Massachusetts Institute of Technology)**

September 2004      ➤ The CONDOR optimizer was recognized as a valuable advance in the field of continuous optimization. As a result, it was installed and made publicly available inside the **world-famous NEOS Server**. See the webpage: <http://neos.mcs.anl.gov/neos/solvers/ndo:condor/AMPL.html>

➤ The CONDOR optimizer was also included inside the famous **Decision Tree for Optimization Software** hosted at: <http://plato.asu.edu/topics/problems/nlores.html#general>

This places CONDOR among the top optimization softwares and expands the field of my **research on optimization at the international level**.

- Secondary school
- 1992 : **1st price in the Informatics Olympic Games** in Belgium. I was send with 2 students to represent Belgium at the World Informatics Olympic Games where I classified among the top 50 out 200.
  - 1991 : 5<sup>th</sup> price Expo-Sciences, Namur, Belgium (subject: calculation of hidden faces on 3D models)
  - 1989 : **1<sup>st</sup> price at Expo-Shell** (subject: binary representation & assembler programming )

## Linguistic knowledge

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➤ **French:** mother tongue

➤ **Dutch:** secondary school knowledge. I also obtained the international certification "Nederlands als Vreemde Taal - graad 2" in the following categories: oral and written comprehension, oral and written expression (There are only 3 grades).

➤ **English:** good level (spoken and written fluently).

## Computer skills

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- Programming Languages** ➤ C/C++ (+MFC: Windows programming); Assembler x86-pentium (demo-coder) ; Assembler 65XX (C64 & apple II); Assembler 8085 ; Assembler Saturn (HP48) ; **Java** (swing, tcp-ip , rmi , jdbc ,...); JavaScript ; Applet Internet in Java ; Matlab ; ADA95 ; SAS ; Pascal ; Fortran ; Scheme ; html ; SQL ;...
- Mathematical Programming** ➤ I have a deep knowledge in **optimization techniques** (continuous and discrete), in **interpolation/regression** techniques, in **classification/regression** techniques, in fuzzy control and in **classical optimal robust control** theory. I had the opportunity to use extensively the lapack and blas libraries, self-adaptive fuzzy controllers, decision trees, lazy learning, multivariate lagrange interpolators, neural networks, evolutive and gradient-based optimization algorithm.
- Network Programming** ➤ **TCP-IP** programming in C&Java ,...; CGI ; client-server applications;...During my work at IRIDIA, I had the opportunity to construct and use a **Beowulf** of 8 nodes.
- Software** ➤ I am familiar with **Matlab** , **Visual C++** , Latex, 3Dstudio Max 2, Photoshop, Dreamweaver, Apache.
- Operating Systems** ➤ **Unix** (Linux and Solaris) and **Windows** 98/XP are more than familiar to me.

# Ambition

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My ambition is to create the softwares of tomorrow. This pushes me to develop new algorithms to create more efficient, fast and precise softwares. To reach these goals, my softwares are using a combination of high-level advanced mathematics and optimized low-level programming.

# Hobbies

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- **Sport:** squash, karting, fencing, scuba diving, KiteSurf, badminton, Horse riding,...
- **Hobbies:** programming, SF books, comics, cinema, rock'n roll dancing, RPG,...