Konstantinos Chatzilygeroudis

Curriculum Vitae

615 rue du Jardin Botanique
Room C121
54600 Villers-lès-Nancy, France
+33 610466287
costashatz@gmail.com
http://costashatz.github.io

In a glance

Current Position	**Doctoral Researcher** at **Inria Nancy - Grand Est**, France
Education	**PhD Candidate in Robotics/Machine Learning**
Honors	Ranked in **top 5%** at **Computer Science and Engineering 2014 Graduation**
Experience	**Google Summer of Code Intern for Open Source Robotics Foundation**
Research Keywords	Robot Learning, Evolutionary Robotics, Machine Learning, Evolutionary Computation

Education

October 2015–present — **PhD in Robotics and Machine Learning**, *University of Lorraine - Inria Nancy (LARSEN Team)*, France.

September 2016 — **Gaussian Process and Uncertainty Quantification Summer School**, *University of Sheffield*, UK.
Organizers: Javier Gonzalez, Richard Wilkinson, Jeremy Oakley, Neil Lawrence, Sheffield ML Group

2009–2014 — **Diploma of Computer Science and Engineering**, *University of Patras*, Greece, *GPA – 8.25/10*.
Specialized in Artificial Intelligence, Robotics, Software Engineering and Computer Graphics - Top 5%

2010–Today — **Online Courses**, *Coursera, edX, Udacity*.
I have attended and completed over 15 online courses covering a very broad range of topics, including Software Engineering, Artificial Intelligence, Robotics, Control Theory, Machine Learning, Game Theory, Digital Signal Processing, e.t.c.

2006–2009 — **High School**, *G.E.L. Kato Kastritsiou*, Patras, Greece, *GPA – 19.3/20*.
Specialized in Mathematics/Physics

Experience

Vocational

October 2015–present — **Doctoral Researcher**, *Inria (LARSEN Team)*, Nancy, France.
Research Topic: Diagnosis-free Damage Recovery in Robotics with Machine Learning and Evolutionary Computation
Funding: ERC "ResiBots" Project
Supervisor: Jean-Baptiste Mouret

January–September 2015 **Computer/Software Engineer**, *Institute of Language and Speech Processing*, Athens, Greece, Scholarship.

Computer/Software Engineer at Institute for Language and Speech Processing, Athens. I was market researching and setting up a laboratory for multi-modal human-computer interaction based on expressive speech synthesis (robots, avatars, motion capture systems, microphone arrays, e.t.c.). My main duties involved searching for available hardware and selecting the most appropriate given specific user/scientific cases. I was, also, involved in integrating *Innoetics'* software into modules of the humanoid robot NAO and creating the infrastructure for easy code re-use.

May–August 2015 **Google Summer of Code 2015**, *Open Source Robotics Foundation*.

As a GSoC 2015 intern, I focused on adding more features to the core library of the *Ignition Robotics Transport Library*. The main tasks involved code restructuring using C++11 features and enabling easy code re-use and enhancing modularity. I was also involved in creating some command line tools for the library.

March–June 2015 **Intern**, *Bit My Job*, Patras, Greece.

During my internship at Bit My Job I developed a framework for Tablet (Android) to Server (Java) communication for live-scoring purposes in shooter tournaments. Also, I created several websites using PHP, Joomla or Wordpress. My internship had a duration of 3 months.

Miscellaneous

Nov–Dec 2013 **Programmer**, *Laboratory for Manufacturing Systems & Automation*, University of Patras, Greece.

Worked on CAPP 4 SMEs European Project. I was developing 3D/2D simulation (using Java and OpenGL) and a Web Application (using Ruby on Rails).

July 2010–June 2015 **Coach**, *Table Tennis Academy "Anagennisi Patron"*, Rion, Greece.

I was the head coach of the Table Tennis Academy "Anagennisi Patron".

Publications

Peer-Reviewed Journals

2017 **Using Centroidal Voronoi Tessellations to Scale Up the Multi-dimensional Archive of Phenotypic Elites Algorithm**, *Vassilis Vassiliades, Konstantinos Chatzilygeroudis, Jean-Baptiste Mouret*, IEEE Transactions on Evolutionary Computation.

The recently introduced Multi-dimensional Archive of Phenotypic Elites (MAP-Elites) is an evolutionary algorithm capable of producing a large archive of diverse, high-performing solutions in a single run. It works by discretizing a continuous feature space into unique regions according to the desired discretization per dimension. While simple, this algorithm has a main drawback: it cannot scale to high-dimensional feature spaces since the number of regions increase exponentially with the number of dimensions. In this paper, we address this limitation by introducing a simple extension of MAP-Elites that has a constant, pre-defined number of regions irrespective of the dimensionality of the feature space. Our main insight is that methods from computational geometry could partition a high-dimensional space into well-spread geometric regions. In particular, our algorithm uses a centroidal Voronoi tessellation (CVT) to divide the feature space into a desired number of regions; it then places every generated individual in its closest region, replacing a less fit one if the region is already occupied. We demonstrate the effectiveness of the new "CVT-MAP-Elites" algorithm in high-dimensional feature spaces through comparisons against MAP-Elites in maze navigation and hexapod locomotion tasks.

Peer-Reviewed Conferences

Sept 2017 **Black-Box Data-efficient Policy Search for Robotics**, *Konstantinos Chatzilygeroudis, Roberto Rama, Rituraj Kaushik, Dorian Goepp, Vassilis Vassiliades, Jean-Baptiste Mouret*, Proceedings of the International Conference on Intelligent Robots and Systems (IROS), Vancouver, BC, Canada, *Supplementary Video*.

The most data-efficient algorithms for reinforcement learning (RL) in robotics are based on uncertain dynamical models: after each episode, they first learn a dynamical model of the robot, then they use an optimization algorithm to find a policy that maximizes the expected return given the model and its uncertainties. It is often believed that this optimization can be tractable only if analytical, gradient-based algorithms are used; however, these algorithms require using specific families of reward functions and policies, which greatly limits the flexibility of the overall approach. In this paper, we introduce a novel model-based RL algorithm, called Black-DROPS (Black-box Data-efficient RObot Policy Search) that: (1) does not impose any constraint on the reward function or the policy (they are treated as black-boxes), (2) is as data-efficient as the state-of-the-art algorithm for data-efficient RL in robotics, and (3) is as fast (or faster) than analytical approaches when several cores are available. The key idea is to replace the gradient-based optimization algorithm with a parallel, black-box algorithm that takes into account the model uncertainties. We demonstrate the performance of our new algorithm on two standard control benchmark problems (in simulation) and a low-cost robotic manipulator (with a real robot).

July 2017 **Comparing multimodal optimization and illumination**, *Vassilis Vassiliades, Konstantinos Chatzilygeroudis, Jean-Baptiste Mouret*, Proceedings of the Genetic and Evolutionary Computation Conference (GECCO) (Poster-only papers), Berlin, Germany.

Illumination algorithms are a recent addition to the evolutionary computation toolbox that allows the generation of many diverse and high-performing solutions in a single run. Nevertheless, traditional multimodal optimization algorithms also search for diverse and high-performing solutions: could some multimodal optimization algorithms be better at illumination than illumination algorithms? In this study, we compare two illumination algorithms (Novelty Search with Local Competition (NSLC), MAP-Elites) with two multimodal optimization ones (Clearing, Restricted Tournament Selection) in a maze navigation task. The results show that Clearing can have comparable performance to MAP-Elites and NSLC.

May 2015 **Human robot collaboration for folding fabrics based on force/RGB-D feedback**, *Panagiotis Koustoumpardis, Konstantinos Chatzilygeroudis, Aris Synodinos, Nikos Aspragathos*, Proceedings of the 24th International Conference on Robotics in Alpe-Adria-Danube Region, Bucharest, Romania, Pages: 235-243.

In this paper, the human-robot collaboration for executing complicated handling tasks for folding non-rigid objects is investigated. A hierarchical control system is developed for the co-manipulation task of folding sheets like fabrics/cloths. The system is based on force and RGB-D feedback in both higher and lower control levels of the process. In the higher level, the perception of the human's intention is used for deciding the robot's action; in the lower level the robot reacts to the force/RGB-D feedback to follow human guidance. The proposed approach is tested in folding a rectangular piece of fabric. Experiments showed that the developed robotic system is able to track the human's movement in order to help her/him to accomplish the folding co-manipulation task.

Peer-Reviewed Workshops

July 2017 **20 Years of Reality Gap: a few Thoughts about Simulators in Evolutionary Robotics**, *Jean-Baptiste Mouret, Konstantinos Chatzilygeroudis*, Proceedings of the International Workshop "Simulation in Evolutionary Robotics" at the Genetic and Evolutionary Computation Conference (GECCO).

Simulators in Evolutionary Robotics (ER) are often considered as a "temporary evil" until experiments can be conducted on real robots. Yet, after more than 20 years of ER, most experiments still happen in simulation and nothing suggests that this situation will change in the next few years. In this short paper, we describe the requirements of ER from simulators, what we tried, and how we successfully crossed the "reality gap" in many experiments. We argue that future simulators need to be able to estimate their confidence when they predict a fitness value, so that behaviors that are not accurately simulated can be avoided.

July 2017 **A comparison of illumination algorithms in unbounded spaces**, *Vassilis Vassiliades, Konstantinos Chatzilygeroudis, Jean-Baptiste Mouret*, Proceedings of the International Workshop "Measuring and Promoting Diversity in Evolutionary Algorithms" at the Genetic and Evolutionary Computation Conference (GECCO).

Illumination algorithms are a new class of evolutionary algorithms capable of producing large archives of diverse and high-performing solutions. Examples of such algorithms include Novelty Search with Local Competition (NSLC), the Multi-dimensional Archive of Phenotypic Elites (MAP-Elites) and the newly introduced Centroidal Voronoi Tessellation (CVT) MAP-Elites. While NSLC can be used in unbounded behavioral spaces, MAP-Elites and CVT-MAP-Elites require the user to manually specify the bounds. In this study, we introduce variants of these algorithms that expand their bounds based on the discovered solutions. In addition, we introduce a novel algorithm called "Cluster-Elites" that can adapt its bounds to non-convex spaces. We compare all algorithms in a maze navigation problem and illustrate that Cluster-Elites and the expansive variants of MAP-Elites and CVT-MAP-Elites have comparable or better performance than NSLC, MAP-Elites and CVT-MAP-Elites.

Dec 2016 **Safety-Aware Robot Damage Recovery Using Constrained Bayesian Optimization and Simulated Priors**, *Vaios Papaspyros, Konstantinos Chatzilygeroudis, Vassilis Vassiliades, Jean-Baptiste Mouret*, BayesOpt 2016: Proceedings of the International Workshop on "Bayesian Optimization" at NIPS 2016, *Supplementary Video*.

The recently introduced Intelligent Trial-and-Error (IT&E) algorithm showed that robots can adapt to damage in a matter of a few trials. The success of this algorithm relies on two components: prior knowledge acquired through simulation with an intact robot, and Bayesian optimization (BO) that operates on-line, on the damaged robot. While IT&E leads to fast damage recovery, it does not incorporate any safety constraints that prevent the robot from attempting harmful behaviors. In this work, we address this limitation by replacing the BO component with a constrained BO procedure. We evaluate our approach on a simulated damaged humanoid robot that needs to crawl as fast as possible, while performing as few unsafe trials as possible. We compare our new "safety-aware IT&E" algorithm to IT&E and a multi-objective version of IT&E in which the safety constraints are dealt as separate objectives. Our results show that our algorithm outperforms the other approaches, both in crawling speed within the safe regions and number of unsafe trials.

May 2016 **Towards semi-episodic learning for robot damage recovery**, *Konstantinos Chatzilygeroudis, Antoine Cully, Jean-Baptiste Mouret*, AILTA '16: Proceedings of the International Workshop "AI for Long-term Autonomy" at ICRA 2016, *Supplementary Video*.
The recently introduced Intelligent Trial and Error algorithm (IT&E) enables robots to creatively adapt to damage in a matter of minutes by combining an off-line evolutionary algorithm and an on-line learning algorithm based on Bayesian Optimization. We extend the IT&E algorithm to allow for robots to learn to compensate for damages while executing their task(s). This leads to a semi-episodic learning scheme that increases the robot's life-time autonomy and adaptivity. Preliminary experiments on a toy simulation and a 6-legged robot locomotion task show promising results.

Reviewer

ICRA 2017 I was reviewer for the IEEE International Conference on *Robotics and Automation 2017*.

IFAC 2017 I was reviewer for the 20th World Congress of the International *Federation of Automatic Control 2017*.

ReMAR 2015 I was reviewer for the 3rd IEEE/IFToMM International Conference on *Reconfigurable Mechanisms and Robots*.

Diploma Thesis

Title *Navigation of Humanoid Robot Nao In Unknown Space With Dynamic Obstacles*

Supervisors Professor Nikos Aspragathos & Professor Emmanouil Psarakis & PhDc Aris Synodinos

Description This thesis dealt with all the fields that give the ability to humanoid robots to move autonomously in a previously unknown space. It was, mainly, a software development project with a brief bibliographic overview of the major algorithms and techniques in each individual field. The "small" humanoid NAO (from Aldebaran Robotics) was used for the experiments and ROS (Robot Operating System) as the programming framework.

Grade 10/10

Videos *NAO Walking in Gazebo*

Code *nao_dcm, nao_gazebo*

Honors & Awards

December 2014 **Computer Engineering and Informatics Department Graduation**.
Ranked **9th with GPA 8.25/10** amongst 250 students that graduated from the Computer Engineering and Informatics Department of University of Patras in 2014.

August 2009 **Greek National Exams - Admission Exams**.
Ranked **1st in admission exams** for the Computer Engineering and Informatics Department of University of Patras among 250 students who succeeded.

May 2010 **Microsoft Imagine Cup Competition**.
Ranked among the **150 best teams** with team TTD (as a game designer/developer) at the Game Development part of the International "Imagine Cup 2010" competition (organized by Microsoft) with the project/game *Spring*.

Skills

Intermediate	Ruby, Screw Theory, XNA, DirectX10, OpenGL, MATLAB/Octave, MVC Web Development with Ruby on Rails or PHP, LaTeX, Javascript/jQuery, Android, HTML5/CSS
Advanced	C/C++, Robotics Operating System (ROS), Java, C#, Python, Object Oriented Design & Programming, Game-Graphics Programming, Math for 2D/3D Graphics

Personal Data

Place/Date of Birth	Nottingham, UK | 5 February 1991
Citizenship	Greek
Marital Status	Married
Address	Nancy, France
Phone	+33 610466287
Website	http://costashatz.github.io/
E-mail	konstantinos.chatzilygeroudis@inria.fr, costashatz@gmail.com
Google Scholar	Konstantinos Chatzilygeroudis *(user=tnf6B-EAAAAJ)*
GitHub	costashatz
Bitbucket	costashatz
Linked-In	konstantinoschatzilygeroudis

Languages

Greek	**Native**	
English	**Full professional proficiency**	*Fluent both in oral and written (C2)*
French	**Elementary proficiency**	*Basic words and phrases only*

Interests

- Artificial Intelligence
- Machine Learning
- Table Tennis
- Robotics
- Programming
- Drawing