



AYUDAS RAMÓN Y CAJAL CONVOCATORIA 2017

Turno de acceso general

Nombre: AGUADO SIERRA, JAZMIN
Referencia: RYC-2017-22532
Área Científica: Ingeniería Mecánica, Naval y Aeronáutica
Correo Electrónico: jazmin.aguado@bsc.es

Título:

Superordenadores y modelización computacional en cardiología

Resumen de la Memoria:

The goal of my research for the next five years is to develop multi-scale and multi-physics simulation platform for biomedical applications like cardiac safety drug testing and medical implantable device testing using anatomically accurate cardiovascular models to be efficiently used in supercomputers. In particular I am a developer and high-end user of Alya, the BSC in-house HPC solver. The objective of my simulations is to reduce and substitute animal testing and to speed up drug and device approval, design and prototyping. Regulatory agencies within Europe and the USA have shown a major interest on this kind of multi-scale, multi-physics, accurate models as well as medical device companies (so-called MedTech). This interest can be clearly seen by the fact that my group in BSC has been contacted by such companies for creating such platform, and we have received a 100K euros donation to contribute to our research in this field.

I am leading the creation of simulations that no one else in the world has ever done because of these main reasons: the computational power and the multi-disciplinary expertise required to create multi-scale / multi-physics physiologically relevant simulations and finally, the access to experimental data required for model verification. I have now established the key collaborations to surpass the state of the art cardiovascular simulations to answer concrete questions relevant to the medical field. It took a few years of hard work coding and developing the mathematical models (we are 40 researchers, engineers and programmers developing Alya, a large-scale simulation tool) and establishing the key collaborations in a country where I had never worked or lived, and had no connections. Some of my collaborators now include the Centro Nacional de Investigaciones Cardiovasculares (CNIC), Centro Nacional de Biotecnología (CNB), University of Minnesota, University of Oxford, Universitat Pompeu Fabra and Medtronic, to name a few. The production period has started and the workgroup and network that I have established is exceptional to further develop new exciting science and insights into cardiovascular disease.

It is important to stress that the nature of my work is and has always been multi-disciplinary, working along with medical doctors, computer scientists, engineers, physicists and mathematicians because modelling biology is not simple and a broad knowledge of various fields is required to create meaningful, useful simulations to understand, diagnose and treat cardiovascular diseases.

It is worth to remark that this work can only be carried out as researcher in the Barcelona Supercomputing Center, where one can find a unique mixture of (1) expertise on computational mechanics, (2) expertise on parallel programming, (3) massive supercomputing resources and (4) top rank interdisciplinary research.

Resumen del Currículum Vitae:

As a Mexican Bioengineer, the objective of my career is to develop computational models of the cardiovascular system to understand its physiology and pathology, creating translational knowledge to the field of Medicine. I have had a successful, international career working at top universities in the UK and USA:

Biomedical Engineering Licenciante degree with Academic Excellence Award from Universidad Nacional Autónoma de México

Granted with a highly competitive scholarship to obtain my PhD degree at the Physiological Flow Studies Group of the Bioengineering Department of Imperial College London in UK, where I was elected the PhD students' representative of the Bioengineering Department.

During my PhD, I developed a 1D mathematical models of blood flow using wave intensity analysis of the systemic arteries including coronary arteries in collaboration with the International Centre for Circulatory Health, London. My PhD thesis established the basis for the new iFR (instantaneous wave-free ratio or Fractional Flow Reserve without Hyperemia), which has been cleared by the FDA and is now being used in hospitals all around the world.

PostDoctoral experience developing Patient-Specific, electro-mechanic models of the heart to study Cardiac Resynchronization Therapy at the Cardiac Mechanics Research Group of the Bioengineering Department of the University of California San Diego, USA.

Current developer and high-end user of Alya, in-house software of the Barcelona Supercomputing Center. I am in charge of various projects and collaborations involving academia, industry and research infrastructures like the European Synchrotron Radiation Facility in Grenoble, France. My collaborations include: Centro Nacional de Investigaciones Cardiovasculares Carlos III, Centro Nacional de Biotecnología, Universitat Pompeu Fabra, Spain; University of Oxford, University College London, University of Edinburgh, University of Sheffield, United Kingdom; University of Minnesota, USA; and my industrial collaborators include: Medtronic, GE Healthcare.

Working experience in the healthcare industry and in an R&D spinoff company, expert consultant on Ventricular Assist Devices, Engineering Department Manager, leading a team of 6 engineers and 3 industrial designers.



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I am involved in the creation of a BSC's spin-off company, ELEM Biotech, to provide simulation services to medical devices industry.



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Nombre: BARTON , MICHAEL
Referencia: RYC-2017-22649
Área Científica: Ingeniería Mecánica, Naval y Aeronáutica
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Título:

Efficient manufacturing of curved objects

Resumen de la Memoria:

My area of research spans geometric modelling, computer aided design (CAD), differential and kinematic geometry, and processing of free-form (NURBS) geometries.

I am interested in modelling of reverse engineering and manufacturing problems. My research focuses on the synergy between geometric modelling and manufacturing, in particular computer numerically controlled (CNC) machining. When manufacturing curved objects (e.g., turbine blades and impellers), their complex geometries prevent them to be manufactured easily, using a single sweep of the milling tool. For example, the optimal tool path planning for 5-axis CNC machining is still an open problem in engineering and applied geometry.

I worked with the leading experts in the field such as Helmut Pottmann (TU Vienna, KAUST), Gershon Elber (Technion), and Bert Juttler (JKU Linz) on several projects in geometric modelling and processing with applications in engineering, e.g. rationalisation of free-form surfaces by envelopes of surfaces of revolution (CNC machining), dynamical 3D linkages (shading systems of curved structures), or sweeps of planar profiles (hot-wire cutting). I also collaborated with industrial partners from ModuleWorks (Germany) and Evolute (Austria) on several reverse engineering projects dealing with rationalization of free-form objects.

In 2016, I joined BCAM as a Bizkaia Talent Research Fellow. I continued my work on approximation of free-form geometries in the context of CNC machining. I started collaboration with the High Performance Manufacturing Group, the University of the Basque Country (UPV), led by Norberto de LaCalle. We incorporated my initialization algorithms into their computer simulations and real-life machining processes (manufacturing of turbine blades and impellers), and improved the accuracy of the final products when compared to the state-of-the-art software (NC module by Siemens), https://www.youtube.com/watch?v=VDjQ_Gcr8Mo.

The main challenge I see for my future research points to flank CNC machining, where the tool (or a set of tools) is traditionally given as the input, instead of being treated as a variable in the manufacturing process. I aim to change this paradigm and design custom-shaped tools to help navigate 5-axis CNC machines, considering the optimal shape of the milling tool as a modelling parameter.

With the boom of 3D printing, custom-shaped tools can be manufactured easily and their price is marginal compared to the cost of the whole manufacturing process (e.g. of a turbine blade). The custom-shaped tools can, however, improve significantly the quality of the milled objects and at the same time reduce the total machining time. My preliminary results in collaboration with the High Performance Machining Group show that the proper shape of the milling tool can further increase the approximation quality by order of magnitude when compared to standard, market milling tools (cones and cylinders). Therefore, a profound mathematical investigation of the input object, followed by machining simulations, should precede the decision process of the choice of the milling tools.

Resumen del Currículum Vitae:

Michael Barton (Prague, Czech Republic, 1979),
PhD in Applied Mathematics (2007).
Currently BCAM Researcher, Bilbao, Spain.

PREVIOUS POSITIONS

03/2016 - 06/2016 Bizkaia Talent Research Fellow, BCAM, Spain,
10/2013 - 02/2016 Research Scientist, Applied Mathematics, KAUST, Saudi Arabia,
10/2010 - 09/2013 Postdoc Research Fellow, GMSV, KAUST, Saudi Arabia,
12/2007 - 09/2010 Postdoc Research Fellow, Computer Science Dept., Technion, Israel,
03/2007 - 11/2007 Postdoc Research Fellow, JKU Linz, Austria,
10/2006 - 02/2007 Assistant Lecturer, CVUT, Prague, Czech Republic,
10/2005 - 09/2006 PhD Research Fellow, RICAM, Linz, Austria.

EDUCATION



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09/2002 - 05/2007 PhD in Applied Mathematics, Charles University, Prague,
09/1997 - 05/2002 MSc in Teaching Mathematics and Descriptive Geometry, Charles University, Prague.

RESEARCH INTERESTS

- geometric modelling of manufacturing processes,
- reverse engineering,
- differential geometry,
- NURBS modelling and processing,
- rigid body kinematics,
- numerical analysis.

RESEARCH STAYS

- 2 pre-doctoral and 6 post-doctoral research stays, e.g. at RICAM and JKU Linz (Austria), Technion (Israel), and KAUST (Saudi Arabia).

PUBLICATIONS

- 29 publications (23 in the first quartile), and 4 preprints submitted,
- Citations: 205 (Scopus); 294 (GoogleScholar),
- h-index: 10 (Scopus); 11 (GoogleScholar).

INTERNATIONAL EXPERIENCE

- 10 years outside Czech Republic, in 4 countries,
- speak 4 languages: Czech, English, German, Spanish,
- published with 24 coauthors of 13 nationalities.

INDUSTRIAL COLLABORATION

- simulations of CNC machining, ModuleWorks GmbH, Germany,
- architectural design and optimisation, Evolute GmbH, Austria.

TEACHING EXPERIENCE

- MSc in teaching mathematics and descriptive geometry,
- taught and examined courses: Calculus I,II,III, Differential Geometry, Constructive Geometry, Geometric Modelling,
- co-supervised 3 research students in one-year projects (Aizenshtein and Shragai at Technion, Reis at Groningen),
- co-supervised 2 PhD candidates (Shi at KAUST, Garcia at BCAM) as a secondary supervisor,
- supervised 1 internship (van Sosin at BCAM) as a primary supervisor.

DISSEMINATION

- gave over 40 talks at international conferences, 3 invited talks at conference mini symposia, and 6 invited talks at research seminars,
- participated in 4 summer schools of mathematics organised for a broad public,
- participated in a course on scientific writing,
- engaged in BCAM PR-activities, e.g. promoting science to non-experts in the [Week of Science](#).

FUNDING

- Bizkaia Talent Fellowship (AYD-000-270, 32 500€),
- Lady Davis Research Fellowship (Technion, 24 000\$),
- succeeded in Marie Skłodowska-Curie individual fellowship call H2020-MSCA-IF-2016 (74%, not funded),
- grant member MTM2016-76329-R (PI David Pardo, 75 100€),
- grant member NSFC-61672187 (PI Pengbo Bo, 80 000€).

MANAGEMENT

- main organiser of the International Conference on Solid and Physical Modelling (SPM 2018), <https://wp.bcamath.org/spm2018/>, est.



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number of participants: 80-100,

- co-organiser of a workshop on Numerical methods in finite elements (May, Bilbao),
- associate editor of Graphical Models (GMOD, Elsevier),
- scientific committee of Geometric Modeling and Processing (GMP), Symposium on Geometry Processing (SGP), Solid and Physical Modeling (SPM).



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Nombre: VALIENTE BLANCO, IGNACIO
Referencia: RYC-2017-23684
Área Científica: Ingeniería Mecánica, Naval y Aeronáutica
Correo Electrónico: ignaciovalienteblanco@gmail.com

Título:

Novel Contactless Magneto-Mechanical Devices for Precision Miniaturized Robotic Manipulators (MEMS) and Energy Harvesting

Resumen de la Memoria:

Existing mechanical technologies for power transmission, mechanisms and actuators create a set of technical drawbacks to certain applications. Contactless magneto-mechanical devices operate similarly to classic mechanical components such as bearings, gearboxes or mechanisms but, by transmitting distant magnetic forces, they eliminate contact between moving parts. Then, friction, wear and fatigue are eliminated. Lubrication is no longer required and maintenance is virtually eliminated. In addition, they can operate in extreme environments (vacuum, radiation, [-200°C to 500°C]) and they provide longer lifetime and higher reliability during operation too. These unique properties of the technology present a great potential for top mechanical engineering fields such as the aerospace, transportation, robotics and medical devices sectors. However, further research is still required.

I hold a bachelor in Mechanical Engineering (2008), a Master in Industrial Engineering (2010), a Master in Machine and Transportation Engineering (2012) and a Master in Fire Protection Engineering (2012) all from University Carlos III of Madrid (UC3M). Since 2013, I am International PhD in Mechanical Engineering (UC3M; Extraordinary Price). I made different pre-doctoral and post-doctoral research stays at different European Institutions such as Strathclyde University (UK), University of Lisbon (Pt), University of Dresden (Ge) or CERN (Ch).

As a result of an intensive research since 2010, I have participated in 15 R&D projects founded by competitive calls, mainly from the FP7, H2020 and ESA. In 4 of them as Principal Investigator (PI) and Project Coordinator (Pc) (more than 1.7M€ in total funding) and in 5 of them as PC and PI of my host institution. Additionally, I have participated in 5 more industrial research projects in collaboration with relevant industrial partners and research centers such as Airbus or Lusospace. As a result, I have presented 66 scientific contributions including 23 peer review JCR/SCOPUS papers, 5 additional peer-review papers in open-access journals, 2 books, 2 book-chapters and 33 contributions to mainly international congresses. I am co-inventor of 5 patents (one currently being commercially exploited) and co-founder of the spin-off company MAGSOAR SL. In addition, I collaborate with various international journal review boards and cooperation networks such as the H2020 Space Strategic Research Cluster, the Research Institute Pedro Juan de Lastanosa or the European Railway Association. I am member of the CEN/TC-256 standardization committee and I have been Spanish Representative in the standardization process of the standard EN-45545.

Currently, I am Responsible of R&D of the spin-off company MAG SOAR SL, where I coordinate a team of 9 engineers and 2 technicians involved in various research projects founded by the European Commission and the European Space Agency. I also collaborate as a researcher and associate professor with Universidad de Alcalá (I have taught more than 350 hours of lessons in three Universities).

Finally, I have received various awards and grants such as a mobility grant from UC3M, the award from partners for the Best FP7 Clean Sky project (Z-Damper Project), Best EUCAS 2013 conference paper or the awards from Madri+d for the Best EU cooperation project (FP7-MAGDRIVE) and best business idea (FP7-COUNTERFOG).

Resumen del Currículum Vitae:

EDUCATION

2013 International PhD. in Mechanical Engineering (UC3M, Cum Laude & Extraordinary Price)
2010-2012: Master in Machines and Transportation Engineering (UC3M, Granted)
2010-2012: Master in Fire Protection Engineering (UC3M, Granted)
2008-2010: Master in Industrial Engineering: Energy Technologies (UC3M)
2004-2008: Bachelor in Mechanical Engineering (UC3M)
Research Stays in Strathclyde University (2012 UK), Lisbon University (2013, Pt), Technical University of Dresden (2010, Ge) and CERN (2010, Ch)

ADDITIONAL BACKGROUND

- Tribology and Space Mechanisms, 9 hours, 2015
- Introduction to MSC/Nastran, 24 hours, 2014
- European Cryogenic Course, 120 hours, 2010
- Mechanical Vibrations and Rotatory Machinery, 14 hours, 2008
- Basic Ventilation Course, 9 hours, 2008
- Certificate in Advance English from Cambridge ESOL, 2013



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PROFESSIONAL EXPERIENCE

10/2014-currently: Head of R&D Department of the spin-off company MAGSOAR
09/2016-currently: Associate Professor Universidad de Alcalá
2013-2017: Researcher at Universidad Carlos III de Madrid (Part Time)
01/2015-06/2015 Associate professor Universidad Alfonso X el Sabio
2010-2013 Full time researcher at Universidad Carlos III de Madrid
05/2008-12/2008 Mechanical Engineer at Soler y Palau S.L.U.

RELEVANT SCIENTIFIC CONTRIBUTIONS

- Participation in 15 R&D projects founded by competitive calls (4 as Principal Investigator) and 5 additional R&D projects founded by non competitive calls. Total funding >1.7M€
- 23 JCR publications (including 3 Q1 and 4 Q2 as first author)
- 5 open source peer review publications
- 2 books and 2 book chapters
- 33 contributions to national and international congresses (25% as first author, 31% as second author)
- 5 patents (one currently being exploited)
- Co-founder of the spin-off company MAGSOAR SL.
- Organization of 4 International Congresses/workshops
- Participation in 10 scientific diffusion activities such as Semana de la Ciencia
- Reviewer in 3 International Journals

TEACHING EXPERIENCE

- More than 350 hours in three different Universities (Universidad Carlos III, Universidad de Alcalá and Universidad Alfonso X el Sabio) in Master and Bachelor courses.
- Director of 7 Master or Bachelor thesis
- 14 sets of lecture notes
- Participation in innovation courses such as the Open Course Ware: "Machine Theory"
- Coordinator of Master Course in Fire Safety Engineering at Universidad de Alcalá

AWARDS AND OTHER MERITS

- Award From Partners: Best project of the FP7 Clean Sky 1 program for the Z-Damper project
- Spanish Representative in the standarization process of the European Standards EN-45545
- Price of Madri+d: best EU research collaboration project for the FP7 Space MAGDRIVE project
- Price of Madri+d: 9º Concurso de ideas para la creación de empresas de base tecnológica: al proyecto empresarial COUNTERFOG
- Best Contribution to EUCAS conference 2013
- Organization of 3 international research congresses and conferences.
- Participation in three different research groups
- Grantt for Master Study (2010-2012), Mobility Grantt (2012)