

Silvia Hervás Raluy

PHD IN BIOMEDICAL ENGINEERING

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Summary

As a researcher at the Technical University of Munich, I am interested in the study of the biomechanics of cancer. My work focuses on the development of computational models that allow us to explore beyond what is seen in the lab or in the human body. To do this, I love to work closely with clinicians and researchers to learn more and more about the processes that trigger and promote the progression of cancer. I enjoy research, answering unsolved questions and finding new challenges.

Education

University of Zaragoza

PHD BIOMEDICAL ENGINEERING

Zaragoza, Spain

17/10/2018 - 30/10/2023

- Thesis: Insights into tumour growth and metastasis: a computational modelling approach
- Advisors: Prof. Dr.-Ing. José Manuel García Aznar and Prof. Dr.-Ing. María José Gómez Benito
- Grade: summa cum laude

University of Zaragoza

MSC IN BIOMEDICAL ENGINEERING

Zaragoza, Spain

1/09/2017 - 11/07/2018

- Thesis: Mechanics and modeling of actin polymerization: the effects on cell motility

University of Zaragoza

BSC IN MECHANICAL ENGINEERING

Zaragoza, Spain

1/09/2013 - 10/07/2017

- Thesis: 3D finite element analysis of migration under conditions of mechanical confinement

Experience

Alexander von Humboldt Postdoctoral Researcher

INSTITUTE FOR COMPUTATIONAL MECHANICS

Technical University of Munich,
Germany

01/03/2025 - Today

Postdoctoral researcher

MULTISCALE IN MECHANICAL AND BIOMEDICAL ENGINEERING

University of Zaragoza, Spain

09/01/2024 - 28/02/2025

- Study of the angiogenesis development during an in vivo tumour growth experiment.
- Collaboration with the Navarra Research Clinical Center (CIMA)
- Unravel the process of cell metabolism in tumour formation.
- Bayesian calibration of a discrete cell model.
- Management of an HPC cluster.

Research Associate

MULTISCALE IN MECHANICAL AND BIOMEDICAL ENGINEERING

University of Zaragoza, Spain

26/11/2018 - 30/11/2023

- Creating a patient-specific tumour growth model that predicts both the prognosis and the effects of the different cancer therapies.
- Intense collaboration with medical partners and coordination of the multiscale model development of the work package.

Visiting Researcher

INSTITUTE FOR COMPUTATIONAL MECHANICS

Technical University of Munich,
Germany

15/09/2021 - 31/03/2022

- Development of a multiphysics phase field model based on porous media to unravel the growth of tumour spheroids.
- Analysis of the model parameters using a global sensitivity approach.
- Application of novel Bayesian techniques to calibrate the model parameters.

Research Assistant

MULTISCALE IN MECHANICAL AND BIOMEDICAL ENGINEERING

- Developing of a numerical method for the calculation of cellular traction forces in 3D through an inverse problem.

University of Zaragoza, Spain

23/10/2017 -31/05/2018

Undergraduate Research Assistant

MULTISCALE IN MECHANICAL AND BIOMEDICAL ENGINEERING

- Developing computational models to simulate the confined cell migration mode.
- Designing microfluids devices in CAD and analysing their behaviour on Abaqus CFD.

University of Zaragoza, Spain

26/09/2016 - 14/11/2016

Publications

Summary and metrics

- 11 publications in peer-reviewed international journals
- h index (Google Scholar): 8
- Number of total citations (Google Scholar): >225

Papers in Scientific Journals

Hervas-Raluy S., Sainz-DeMena, D., Gomez-Benito M. J., Garcia-Aznar J. M. Image-based biomarkers for engineering neuroblastoma patient-specific computational models. *Engineering with Computers* (2024): 1-17

Borau, C., Wertheim K. Y., **Hervas-Raluy, S., Sainz-DeMena, D., Walker, D., Chisholm, R., Richmond, P., Varella, V., Viceconti, M., Montero, A., Gregori-Puigjané, E., Mestres, J., Kasztelnik, M., Garcia-Aznar, J. M.** A multiscale orchestrated computational framework to reveal emergent phenomena in neuroblastoma. *Computer Methods and Programs in Biomedicine* 241 (2023): 107742

Juste-Lanas, Y., **Hervas-Raluy, S., Garcia-Aznar, J. M., Gonzalez-Loyola, A.** Fluid flow to mimic organ function in 3D in vitro models. *APL bioengineering* 7.3 (2023)

Hervas-Raluy, S., Wirthl, B., Guerrero, P.E., Robalo Rei, G., Nitzler, J., Coronado, E., Font de Mora Sainz, J., Schrefler, B. A., Gomez-Benito, M.J., Garcia-Aznar, J.M., Wall, W. A. Tumour growth: An approach to calibrate parameters of a multiphase porous media model based on in vitro observations of Neuroblastoma spheroid growth in a hydrogel microenvironment. *Computers in Biology and Medicine* 159 (2023): 106895

Pérez-Benito, A., Huerta-López, C., Alegre-Cebollada, J., García-Aznar, J.M., **Hervas-Raluy, S.** Computational modelling of the mechanical behaviour of protein-based hydrogels. *Journal of the mechanical behavior of biomedical materials* 138 (2023): 105661.

Merino-Casallo, F., Gomez-Benito, M. J., **Hervas-Raluy, S., Garcia-Aznar, J. M.** Unravelling cell migration: defining movement from the cell surface. *Cell Adhesion and Migration* 16.1 (2022): 25-64

Quintela, B. D. M., **Hervas-Raluy, S., Garcia-Aznar, J. M., Walker, D., Wertheim K. Y., Viceconti, M.** A Theoretical Analysis of the Scale Separation in a Model to Predict Solid Tumour Growth. *Journal of Theoretical Biology* 547 (2022): 111173

Juste-Lanas, Y., Guerrero, P. E., Camacho-Gomez, D., **Hervas-Raluy, S., Garcia-Aznar, J. M., Gomez-Benito, M. J.** Confined Cell Migration and Asymmetric Hydraulic Environments to Evaluate the Metastatic Potential of Cancer Cells. *ASME. Journal of Biomechanical Engineering* 144.7 (2022): 074502

Garcia-Aznar J.M., Nasello G., **Hervas-Raluy S., Perez M.A., Gomez-Benito M.J.** Multiscale modeling of bone tissue mechanobiology. 151 (2021): 116032

Hervas-Raluy S., Gomez-Benito M. J., Borau-Zamora C., Condor M., Garcia-Aznar J. M. A new 3D finite element-based approach for computing cell surface tractions assuming nonlinear conditions. *PLoS ONE* 16.4 (2021): e0249018

Hervas-Raluy S., Garcia-Aznar J. M., Gomez-Benito M. J. Modelling actin polymerization: the effect on confined cell migration. *Biomechanics and Modeling in Mechanobiology* 18 (2019): 1177-1187

Peer-reviewed Conference Proceedings

Cerdá-Alberich L., Veiga-Canuto D., Fernández-Patón M., **Hervas-Raluy S., Sainz-deMena D., Borau C., García-Aznar JM., Martí-Bonmatí L.** Harnessing multimodal clinical predictive models for childhood tumors In 2023 IEEE EMBS Special Topic Conference on Data Science and Engineering in Healthcare, Medicine and Biology (pp. 71-72). IEEE

Hervas-Raluy, S., Wirthl, B., Guerrero, P.E., Robalo Rei, G., Nitzler, J., Coronado, E., Font de Mora Sainz, J., Schrefler, B. A., Gomez-Benito, M.J., Garcia-Aznar, J.M., Wall, W. A. Combining experiments and computational simulations to unravel the mechanics of spheroid tumour growth In 2022 CMBE Conference on Computational and Mathematical Biomedical Engineering (pp. 669)

Conferences

Oral Presentations

Speaker name is underlined. An asterisk indicates supervised students.

- Sainz-DeMena, D., **Hervas-Raluy S.**, Perez-Benito A., Gomez-Benito M. J., Garcia-Aznar J. M., Perez M. A. 8th Conference on Virtual Physiological Human (VPH). Digital twins for oncology and patient-specific simulations: importance of vascularization. Stuttgart (Germany) September 4-6, 2024.
- Hervas-Raluy S.**, Sainz-DeMena, D., Garcia-Aznar J. M., Gomez-Benito M. J. 29th Congress of the European Society of Biomechanics (ESB). Modelling neuroblastoma tumour evolution: a personalised diagnosis based on imaging data. Edinburgh (Ireland) July 1-3, 2024.
- Hervas-Raluy S.**, Sainz-DeMena, D., Gomez-Benito M. J., Garcia-Aznar J. M. Mechanobiology Across Scales. Integrating radiomic and cell mechanobiology to predict tumour response to treatment. Nice (France), April 2-5, 2024.
- Cerdá-Alberich L., Veiga-Canuto D., Fernández-Patón M., **Hervas-Raluy S.**, Sainz-deMena D., Borau C., García-Aznar JM., Martí-Bonmatí L. IEEE EMBS International Conference on Data Science and Engineering in Healthcare, Medicine & Biology. Harnessing multimodal clinical predictive models for childhood tumors. St. Julians (Malta), December 7-9, 2023.
- Hervas-Raluy S.**, Sainz-DeMena, D., Gomez-Benito M. J., Garcia-Aznar J. M. 10th International Conference on Computational Bioengineering (ICCB). Insights into the Biomechanics and Clinical Implications of Neuroblastoma Tumour Evolution Modelling. Vienna (Austria), September 20-22, 2023.
- Perez-Benito A.* , **Hervas-Raluy S.**, Perez M. A. 10th International Conference on Computational Bioengineering (ICCB). In-silico modelling of prostate cancer growth. Vienna (Austria), September 20-22, 2023.
- Hervas-Raluy S.**, Sainz-DeMena, D., Gomez-Benito M. J., Garcia-Aznar J. M. 10th GACM Colloquium on Computational Mechanics. Modelling neuroblastoma tumour evolution: biomechanical insights and clinical implications. Vienna (Austria), September 10-13, 2023.
- Hervas-Raluy, S.**, Wirthl, B., Guerrero, P.E., Robalo Rei, G., Nitzler, J., Schrefler, B. A., Gomez-Benito, M.J., Garcia-Aznar, J.M., Wall, W. A. 7th International Conference on Computational & Mathematical Biomedical Engineering (CMBE). Combining experiments and computational simulations to unravel the mechanics of spheroid tumour growth. Milan (Italy), June 27-29, 2022.
- Hervas-Raluy S.**, Sainz-DeMena, D., Gomez-Benito M. J., Garcia-Aznar J. M. 11th European Solid Mechanics Conference (ESMC). Analysis of Neuroblastoma tumour evolution through a Finite Element based model. Galway (Ireland), July 4-8, 2022.
- Hervas-Raluy S.**, Sainz-DeMena, D., Perez M. A., Gomez-Benito M. J., Gonzalves I., Camacho D., Guerrero P., Garcia-Aznar J. M. 7th Conference on Virtual Physiological Human (VPH): Invited talk: Patient-specific models in tumor growth: integrating organoids and image-based biomarkers. Porto (Portugal), September 6-9, 2022.
- Hervas-Raluy S.**, Sainz-DeMena, D., Perez M. A., Gomez-Benito M. J., Guerrero P., Borau C., Gonzalves I., Camacho D., Garcia-Aznar J. M. 8th Kick-off meeting of Pediatric Oncologic Surgeons (GRECOP). PRIMAGE project: Computational simulation model of neuroblastoma growth and 3D cell culture on microfluidic chips. Zaragoza (Spain), November 11, 2022.
- Hervas-Raluy S.**, Gomez-Benito M. J., Garcia-Aznar J. M. 16th International Conference on Computational Plasticity. Fundamentals and Applications (COMPLAS). Computer-based modeling and simulation of neuroblastoma growth. Barcelona (Spain), hybrid (in the context of the COVID-19 pandemic), September 7-9, 2021.
- Hervas-Raluy S.**, Gomez-Benito M. J., Borau-Zamora C., Condor M., Garcia-Aznar J. M. 16th International Conference on Computational Plasticity. Fundamentals and Applications (COMPLAS). A 3D finite element-based approach for computing cellular forces under large deformations. Barcelona (Spain), hybrid (in the context of the COVID-19 pandemic), September 7-9, 2021.
- Hervas-Raluy S.**, Gomez-Benito M. J., Borau-Zamora C., Condor M., Garcia-Aznar J. M. 17th International Symposium on Computer Methods in Biomechanics and Biomedical Engineering (CMBBE) Quantifying cellular forces: a FE-based algorithm for traction force microscopy. Bonn (Germany), online (in the context of the COVID-19 pandemic), September 7-9, 2021.
- Garcia-Aznar J. M., Nasello G., **Hervas-Raluy S.**, Perez M. A., Gomez-Benito M. J. 17th International Symposium on Computer Methods in Biomechanics and Biomedical Engineering (CMBBE) Invited talk: Numerical multiscale modeling of bone mechanobiology. Bonn (Germany), online (in the context of the COVID-19 pandemic), September 7-9, 2021.
- de Melo Quintela B., **Hervas-Raluy S.**, Garcia-Aznar J. M., Walker D., Wertheim K. Y., Viceconti M. 2nd CompBioMed Conference: Building the Virtual Human. A Scale Separation Approach Applied to a Mathematical Model of Solid Tumour Growth. Virtual conference, September 15-17, 2021.
- Juste-Lanas, Y., Guerrero, P. E., Camacho-Gomez, D., **Hervas-Raluy, S.**, Garcia-Aznar, J. M., Gomez-Benito, M. J. 10th Conference of Young Researchers of the Engineering Research Institute of Aragon. New microfluidic devices for the study of metastatic ability and the effect of barotaxis. Zaragoza (Spain), October 21, 2021.
- Hervas-Raluy S.**, Gomez-Benito M. J., Borau-Zamora C., Garcia-Aznar J. M. 9th Conference of Young Researchers of the Engineering Research Institute of Aragon. Are the cells stronger than we think?. Zaragoza (Spain), hybrid (in the context of the COVID-19 pandemic), December 11, 2020.
- Hervas-Raluy S.**, Gomez-Benito M. J., Borau-Zamora C., Condor M., Garcia-Aznar J. M. 6th Conference on Virtual Physiological Human (VPH). Iterative methodology for solving cell traction forces inverse problem under finite strains. Paris (France), online (in the context of the COVID-19 pandemic), August 24-28, 2020.
- Hervas-Raluy S.**, Gomez-Benito M. J., Borau-Zamora C., Garcia-Aznar J. M. 9th Meeting of the National Chapter of the Spanish Society of Biomechanics (ESB). Recovery of cell traction forces. Las Palmas de Gran Canaria (Spain), October 24-25, 2019.
- Hervas-Raluy S.**, Gomez-Benito M. J., Garcia-Aznar J. M. 5th Conference on Virtual Physiological Human (VPH) Finite element analysis of individual cell migration under conditions of mechanical confinement. Zaragoza (Spain), September 5-7, 2018.

Gomez-Benito M. J., Juste Y., Serrano-Alcalde F., **Hervas-Raluy S.**, Garcia-Aznar J. M. 23rd Congress of the European Society of Biomechanics (ESB). Cell movement in confined microenvironments. Seville (Spain), July 2-5, 2017.

Poster Presentations

Garcia-Gomez P.*; **Hervas-Raluy S.**; Garcia-Aznar J. M. 29th Congress of the European Society of Biomechanics (ESB). Metabolism and mechanics of tumor spheroids through an agent-based computational model. Edinburgh (Ireland) July 1-3, 2024.

Hervas-Raluy S., Sainz-DeMena, D., Gomez-Benito M. J., Garcia-Aznar J. M. 11th Conference of Young Researchers of the Engineering Research Institute of Aragon. In-silico based clinical decision support tool for paediatric cancer. Zaragoza (Spain), June 16, 2022.

Hervas-Raluy S., Gomez-Benito M. J., Borau-Zamora C., Condor M., Garcia-Aznar J. M. Multiscale Mechanochemistry & Mechanobiology from molecular mechanisms to smart materials. May the force be with cells. Virtual Conference, August 23-25, 2021.

Hervas-Raluy S., Gomez-Benito M. J., Condor M., Garcia-Aznar J. M. 25th Congress of the European Society of Biomechanics(ESB). Finite element model of actin polymerization during confined cell migration. July 7-10, 2019, Vienna (Austria)

Invited seminars

Hervas-Raluy, S., Wirthl, B., Guerrero, P.E., Robalo Rei, G., Nitzler, J., Schrefler, B. A., Gomez-Benito, M.J., Garcia-Aznar, J.M., Wall, W. A. IUMA day on Numerical Methods for Porous Media Problems: Combining experiments and a multiphase model to unravel the mechanics of spheroid tumor growth. Zaragoza (Spain), January 10, 2024.

Hervas-Raluy, S. Seminar Series of the Biomedical Engineering M.Sc.: Insights into tumour growth and metastasis: a computational modelling approach. Zaragoza (Spain), January 24, 2024.

Participation in Conference Committees

Meeting of the Spanish ESB National Chapter

Zaragoza, Spain

24-25/10/2022

Responsible for the web-based conference management software system (EasyChair), abstract submission and review procedures, conference poster design, build of the conference proceedings, IT support in the conference rooms.

5th International Conference Virtual Physiological Human (VPH)

Zaragoza, Spain

05-07/09/2018

Participants reception, IT support in the conference rooms.

Awards, Fellowships, & Grants

01/03/2025	Humboldt Research Fellowship , Alexander von Humboldt Foundation	€68240
01/01/2025	Seal of Excellence (90.2/100) , Postdoctoral Fellowships - Marie Skłodowska-Curie Actions	-
01/01/2025	Rejected, Postdoctoral Fellowship , Fundacion Alfonso Martin Escudero	€68000
02/07/2024	Best Doctoral Thesis Runner-up , European Society of Biomechanics	€250
22/06/2022	Best Biomedical contribution Young Researchers Conference , Institute of Research of Aragon	-
15/09/2021 - 31/03/2022	Research Stay Grant , Fundacion Ibercaja CAI	€3200
15/01/2022 - 31/03/2022	Research Stay Grant , Erasmus +	€887
15/09/2021 - 14/12/2021	Short-Term Grant , German Academic Exchange Service (DAAD)	€4025
1/12/2019 - 30/11/2023	Research Fellowship , Government of Aragon	€84000
Jun. 2017	Best Mechanical Engineering BCs Thesis , Aragon Mechanical Engineers Society	€300

Teaching Experience

Spring 2020, 2021, 2022	Prostheses and implants design , Teaching Assistant
Spring 2021, 2022	Cell mechanics and mechanobiology , Teaching Assistant
Fall 2020	Continuum Mechanics , Teaching Assistant
Spring 2020	Musculoskeletal tissue modelling , Teaching Assistant
Spring 2020	Strength of Materials , Teaching Assistant
2020-2024	Supervision of MCs and BCs theses ,

Participation in research projects

TUMATRIXMODELING: Predictive modeling and simulation of patient-derived tumor organoids: unraveling the role of matrix stiffness and glucose metabolism on tumor growth

MCIN/AEI/FEDER, UE

PI: DR. JOSE MANUEL GARCIA AZNAR

11/2023-Today

- This project explores the relationship between the composition and mechanical properties of the tumour extracellular matrix and the glucose metabolic activity of the tumours, which in turn relates to their growth and resistance to therapies.

PRIMAGE: PRedictive In-silico Multiscale Analytics to support cancer personalized diaGnosis and prognosis, Empowered by imaging biomarkers

Horizon2020

PI: DR. LUIS MARTI BONMATI

01/03/2019 - 01/09/2023

- This project proposes an open cloud-based platform to support decision making in the clinical management of two paediatric cancers, Neuroblastoma (NB) and the Diffuse Intrinsic Pontine Glioma (DIPG).

IMAGO: Image Analysis Online Services for in-vitro experiments

ERC-2016-PoC

PI: PROF. JOSÉ MANUEL GARCÍA AZNAR

23/10/2018 - 29/02/2019

- IMAGO presents the development of a tool for image analysis focused on, but not limited to, the quantification of cell behavior under different conditions. Indeed, IMAGO goes further by providing, when applicable, an image-based finite element analysis (FEA).

INSILICO-CELL: Predictive modelling and simulation in mechano-chemo-biology: a computer multi-approach

ERC-2012-StG

PI: PROF. JOSÉ MANUEL GARCÍA AZNAR

23/10/2017 - 31/05/2018

- in silico and in vitro models are combined to investigate how environmental conditions drive cell behaviour, how individual cell behaviour generates multicellular patterns, how cells respond to the multicellular environment, how cells are able to generate new tissues and how cell-matrix interactions affect these processes.

Outreach & Professional Development

Reviewer in Scientific Journals

Computers in Biology and Medicine, Scientific Reports, PLOS ONE, Biomechanics and Modelling in Mechanobiology.

Workshops and dissemination

Aragon Mechanical Engineers Society, COGITIAR

Zaragoza, Spain

INTERVIEW

Feb. 2025

- Associate of the month (Colegiada del mes)

Heraldo de Aragón

Zaragoza, Spain

ARTICLE IN NEWSPAPER

Feb. 2023

- Cancer: models that predict how your tumour will evolve (Cáncer: modelos que predicen cómo evolucionará tu tumor)

PRIMAGE Platform functionalities & Multiscale modelling of tumour growth

Online

WORKSHOP

Jun. 2022

- Multiscale modelling of tumour growth.

Aragón Radio

Zaragoza, Spain

PODCAST IN THE REGIONAL RADIO

Jan. 2019

- Computer engineering to study paediatric tumours (Ingeniería computacional para estudiar tumores pediátricos)

Membership in Academic Institutions

European Society of Biomechanics (ESB)

Virtual Physiological Human (VPH)

German Association of Computational Mechanics (GACM)

Courses

Introduction to artificial intelligence applied to medical imaging

International workshop on bone mechanics and tissue engineering

Graphic design and creativity: posters as a tool for dissemination

Pedagogical training course for new university teachers

Academic English