



**UNIVERSITY: Public University of Navarre (UPNA)**

**WIT PROGRAMME'S RESEARCH LINE NAME:** Automatic control of life cycles for in vitro neuron cultures using computer vision

**DOCTORAL PROGRAMME:** Doctorate in Science and Industrial Technologies  
<https://www.unavarra.es/escuela-doctorado/doctorate-programs/current-plan/science/doctorate-in-science-and-industrial-technologies?languageId=1>

#### **COMPLETE DESCRIPTION OF THE LINE**

Neurodegenerative diseases (NDs) are one of the most prolific areas of medical research in recent years, especially due to the severe impact they have on the quality of life of both patients and their relatives. Within the efforts to counteract the effects of NDs, such as ALS or Alzheimer's, a relevant trend is based on experimentation with treatments that lengthen the life of neurons. These treatments are tested in in vitro cultures. Although laboratory techniques and equipment have reduced their price and performance, the process finds a bottleneck in the analysis of the cultures, which must be done manually by experts. This represents a significant personal and financial cost, which effectively cause a limitation to the scope of the experiments.

This line proposes an automatic system to control life/death cycles of neurons in time series of microscopic images. This will automate the experimental analysis of the different neurobiology laboratories in Navarra, rendering in both a reduction in personal/material costs and a greater capacity for experimentation.

#### **RESEARCH GROUP NAME:**

Grupo de Investigación en Inteligencia Artificial y Razonamiento Aproximado (GIARA).



### COORDINATOR:

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### MEMBERS OF THE LINE RESEARCH:

- Humberto Bustince Sola (UPNA & NavarraBiomed)
- Carlos López Molina (UPNA & NavarraBiomed, Tutor)
- Montserrat Arrasate Iragui (CIMA & UN, Tutor)
- Bernard de Baets (UGent)

### ANOTHER RESEARCH LINES OF THE GROUP: short description of each of them

- Fuzzy Set Theory and Approximate Reasoning
- Information aggregation and fusion operators
- Machine Learning, Neural Networks and Deep Learning
- Industrial, agronomic and medical image processing
- Medical and biotech data analysis
- Clustering and classification based on fuzzy rules

- Entities involved in research lines and contact person:



✓ Academic entities:

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- Joint supervision of doctoral thesis with international universities or non academic institutions:



- Sesma-Sara, Mikel, *Generalized forms of monotonicity in the data aggregation framework*, H. Bustince (UPNA), R. Mesiar (Slovak Technical University) Universidad Pública de Navarra 2019.
- De Miguel Turullols, Laura, *Computing with uncertainly truth degrees: a convolution-based degrees*. H. Bustince (UPNA), B. De Baets (Ghent University), 2017.
- Paternain Dallo, Daniel *Optimization of image reduction and restoration algorithms based on penalty functions and aggregation techniques*, H. Bustince (UPNA), F.J Fernández (UPNA), G. Beliakov (Deakin University), 2013.
- Lopez Molina, Carlos, *The Breakdown structure of edge detection: Analysis of individual components and revisit of the overall structure*. H. Bustince (UPNA), B. De Baets (Ghent University), 2012.

- Group review

The Artificial Intelligence and Approximate Reasoning Research Group (GIARA) began its trajectory focused on mathematical modeling, especially in the context of Fuzzy Set Theory. The experience gained in this line generated different theoretical-practical research, mostly based on machine learning and/or computer vision. This research has led to advances in topics as varied as automatic control, food safety, big data or convolutional/deep neural networks. Beyond the academic impact, the ability to connect mathematical theory with advanced technical tools has led to developments applied in industrial, agrobiotechnological and medical environments. To date, GIARA has generated more than 400 indexed articles, collaborating with more than 200 different authors, and it is actively involved in projects with researchers from 4 continents.

- Link of the group to the “Portal of scientific production”

<https://academicos.unavarra.es/CawDOS/?id=1adf33dba1eb5382&idioma=es&tipo=actGrupo>



- Pictures, links... to academic or industrial partners (if any)
  - UPNA: [www.unavarra.es](http://www.unavarra.es)
  - NavarraBiomed: [www.navarrabiomed.es](http://www.navarrabiomed.es)
  - CIMA: [cima.cun.es](http://cima.cun.es)
  - Ghent University, Bioscience Engineering: [www.ugent.be/bw/en](http://www.ugent.be/bw/en)
  - ADEMNA: [www.esclerosismultiplenavarra.com](http://www.esclerosismultiplenavarra.com)
  - ANELA: [www.anelanavarra.es](http://www.anelanavarra.es)

## CANDIDATE REQUISITES

Degree in Computer Sciences or Mathematics.

The candidate shall ideally have some experience in bio-related projects and/or developments. Also, needs to be open to integration in a multidisciplinary team involving different experts in the field. Experience in computer vision or signal processing is recommended.