# Jesús Vellojin

## Personal Information


- **Country of birth:** Colombia
- **City of birth:** Cartagena, Bolívar
- **Age:** 37 years
- **R.U.N.:** 25.283.483-4
- **Marital status:** Married
- **Date of birth:** November 23, 1987
- **Address:** Philippi 129, Valparaiso, Chile
- **Telephone:** +56952347706
- **e-mail:** jesusvellojin@gmail.com


## Education

2020 **PhD in mathematics**, *Doctorado en consorcio USM-PUCV-UV*, Valparaíso-Chile.

- Degree: Doctor en Matemática
- Research interest: Numerical Analysis, Scientific Computation, Finite Element Method, Virtual Element Method, Slender Structures, Elasticity and Viscoelasticity, Eigenvalue Problems, Coupled problems, Non-linear problems.
- Thesis tittle: Análisis Numérico de Estructuras Viscoelásticas Delgadas. Advisor: Dr. Erwin Hernández

2015 **Master degree in mathematics**, *Universidad del Norte*, Barranquilla-Colombia.

- Degree: Magíster en Matemáticas
- Thesis title: Análisis e Implementación de Métodos de Descomposición de Dominios para un problema de Stokes. Advisor: Dr.rer.nat. Ricardo Prato Torres

2011 **Mathematics**, *Universidad de Cartagena*, Cartagena-Colombia.

- Degree: Matemático
- Thesis title: Homología y Homotopías en Retículos Finitos. Advisor: Joaquin Luna Torres

## Languages

Spanish **First language**

English **Advanced** *Fluid in writting, reading and conversation*

## Computer skills

| | |
|---|---|
| Basic | C,C++, HTML |
| Intermediate | MAPLE, Bash, Gmsh, Freefem++, Julia, Gridap, VEM++ |
| Advanced | LaTeX, Microsoft Windows, MATLAB, Linux, Python, Fenics, Fenicsx, DUNE |

## Research projects and stays

2025 **Research Stay (2 Februrary-2 March)**, *Università Milano - Bicocca*, Milan, Italy.

- Goal: New computational tools for the implementation of the virtual element method in 2D and 3D for the simulation of fluid and solid mechanics problems.

2023 **Research Stay (08 March-08 May)**, *Monash University*, Melbourne, Australia.

- Goals: Construction and analysis of new discretisations for coupled flow-transport problems that are relevant in desalination processes.

2023-2026 **Mathematical and computational analysis of solid and fluid mechanics**, *Postdoctoral Fondecyt 330302. Universidad del Bío-Bío*, Chile.

- Position: Postdoctoral researcher
- Functions: Numerical implementation of elastic and solid vibrations models. Finite element of fluid-structure interactions and viscoelastic slender structures.

2022-2023 **Anillo of computational mathematics for desalination processes**, *ACT210087. Universidad del Bío-Bío*, Chile.

- Position: Postdoctoral researcher
- Functions: Numerical implementation of non-linear coupled fluid-transmission problems. Finite element analysis of Reverse Osmosis process.

2018-2022 **Further development in numerical methods for thin structures and applications**, *FONDECYT-1181098. Universidad Técnica Federico Santa María*, Chile.

- Position: Phd-student researcher (2018-2020). Technical staff and programmer (2020-2022)
- Functions: Analysis of thin structures, including solutions through numerical methods.

2012-2013 **Acople de elementos finitos y elementos de frontera usando la técnica de Nitsche**, *Universidad del Norte*, Barranquilla, Colombia.

- Position: MATLAB programmer
- Functions: Elaborate MATLAB codes to solve an optimal control problem in elasticity using the Nitsche technique.

## Publications

2024 **Lepe, F., Rivera, G., and Vellojin, J.**, *Finite element analysis for the Navier-Lamé eigenvalue problem*, Applied Numerical Mathematics (APNUM), In press.
https://doi.org/10.1016/j.apnum.2024.09.023

2024 **Lepe, F., Rivera, G., and Vellojin, J.**, *Finite Element Analysis of the Oseen eigenvalue problem*, Computer Methods in Applied Mechanics and Engineering (CMAME), 425, 116959, 2024.
https://doi.org/10.1016/j.cma.2024.116959

2024 **Carro, N., Mora, D., and Vellojin, J.**, *A finite element model for concentration polarization and osmotic effects in a membrane channel*, International Journal for Numerical Methods in Fluids, 96, 5, 601–625.
https://doi.org/10.1002/fld.5252

2023 **Lepe, F., Mora, D., and Vellojin, J.**, *Discontinuous Galerkin methods for the acoustic vibration problem*, Journal of Computational and Applied Mathematics, 441, 15 May 2024, 115700.
doi: 10.1016/j.cam.2023.115700

2023 **Hernández, E., Lepe, F., and Vellojin, J.**, *A mixed parameter formulation with applications to linear viscoelastic slender structures*, ESAIM: Mathematical Modelling and Numerical Analysis, 58, 1,157–189.
https://doi.org/10.1051/m2an/2023099

2023 **Lepe, F., and Vellojin, J.**, *A posteriori analysis for a mixed formulation of the Stokes spectral problem*, Calcolo, 60(4):52.
doi: 10.1007/s10092-023-00548-y

2023 **Lepe, F., Rivera, G., and Vellojin, J.**, *Error estimates for a vorticity-based velocity–stress formulation of the Stokes eigenvalue problem*, Journal of Scientific Computing, 93,1, 10.

2022 **Lepe, F., Rivera, G., and Vellojin, J.**, *A Posteriori Analysis for a Mixed FEM Discretization of the Linear Elasticity Spectral Problem*, Journal of Computational and Applied Mathematics, 40, 114798.

2022 **Lepe, F., Rivera, G., and Vellojin, J.**, *Mixed methods for the velocity-pressure-pseudostress formulation of the Stokes eigenvalue problem*, SIAM Journal on Scientific Computing (SISC), 44, Issue 3, A1358-A1380.

2021 **Hernández, E. and Vellojin, J.**, *A locking-free finite element formulation for a non-uniform linear viscoelastic Timoshenko beam*, Computers & Mathematics with Applications, 99. 305-322.

2020 **Hernández, E., Naranjo, C., and Vellojin, J.**, *Modelling of thin viscoelastic shell structures under Reissner-Mindlin kinematic assumption*, Applied Mathematical Modelling, 79. 180-199.

## Talks

2024 **A divergence-free conforming discretization of a flow-transport coupling model with applications to reverse osmosis systems**, *Coloquio de Matemáticas y Estadística*, Universidad del Norte, Barranquilla, Colombia.

2024 **Finite Element Analysis Of The Oseen Eigenvalue Problem**, *Seventh Chilean Workshop on Numerical Analysis of Partial Differential Equations (WONAPDE)*, Universidad de Concepción, Concepción, Chile.

2024 **A Divergence-Free Finite Element Method For Flow-Transport Coupling With Osmotic Effects**, *Seventh Chilean Workshop on Numerical Analysis of Partial Differential Equations (WONAPDE)*, Universidad de Concepción, Concepción, Chile.

2023 **Finite elements in the study of a concentration polarization and osmotic effects in a membrane channel**, *International Conference on Spectral and High Order Methods (ICOSAHOM)*, Yonsei University, Seoul, Korea.

2023 **Finite element analysis for the Navier-Lamé eigenvalue problem**, $10^{\text{th}}$ *International Congress on Industrial and Applied Mathematics (ICIAM)*, Waseda University, Tokyo, Japan.

2022 **Finite elements in the study of a concentration polarization and osmotic effects in a membrane channel**, *Workshop Matemática Multidisciplinar, "Uso de Herramientas Matemáticas en problemas aplicados"* , Universidad del Bío-Bío, Concepción, Chile.

2022 **Herramientas computacionales en procesos de desalinización de agua**, *IV Expoengineering 2022: Ciencia de Datos: su aplicación en la ingeniería y la tecnología para innovar y emprender*, Fundación Universitaria Colombo Internacional UNICOLOMBO, Cartagena, Colombia.

2022 **Mixed methods for the velocity-pressure-pseudostress formulation of the Stokes eigenvalue problem**, *XXXIV Jornada de Matemática de la Zona Sur* , Universidad de Los Lagos, Osorno, Chile.

2021 **A Numerical Analysis of Linear Viscoelasticity and Slender Structures**, *XI Escuela Internacional de Matemáticas del Caribe*, Universidad de Cartagena, Bolívar, Colombia.

2021 **Analysis of an abstract mixed formulation with applications to linear viscoelasticity**, *XXIX Congreso de Matemáticas Capricornio (COMCA)*, Universidad de Atacama, Copiapó, Chile.

2019 **An approach to the numerical analysis of thin viscoelastic structures**, *Research Seminary*, Universidad da Coruña , A Coruña, España.

2019 **A locking-free finite element scheme for thin viscoelastic structures**, *International Congress on Industrial and Applied Mathematics (ICIAM 2019)*, Universidad de Valencia , Valencia, España.

2019 **A locking-free finite element scheme for linear viscoelastic Timoshenko curved rods**, *XXVIII Congreso de Matemáticas Capricornio (COMCA)*, Universidad de La Serena , La Serena, Chile.

2019 **Discretization of a mixed formulation for linear viscoelastic Timoshenko curved rods**, *Congreso Colombiano de Matemáticas CCM2019*, Universidad del Cauca, Popayán, Colombia.

2018 **Discretization of a linear viscoelastic Timoshenko beam using reduced integration techniques**, *Jornada Matemática de la Zona Sur*, Universidad Austral, Valdivia, Chile.

## Research results

My research is distinguished by a strong computational focus, emphasizing efficiency and robustness as fundamental pillars. I can provide innovative computational tools for solving and validating various mathematical models using a range of numerical methods. This approach not only ensures the reliability of the solutions but also promotes the advancement of practical applications in mathematical and computational sciences.

## Shared connections

**Ricardo Ruiz-Baier** (Monash University, Melbourne, Australia)
- Hdiv confoming with applications to reverse osmosis systems
- Contact problems
- Fluid-Structure problems

**Arbaz Khan** (Indian Institute of Technology Roorkee, India)
- Eigenvalue problems using DG and HDG methods in Stokes and Elasticity problems
- Fluid-Structure problems
- Non-linear eigenvalue problems

**Nitesh Verma** (Universidad del Bio-Bio, Concepción, Chile)
- Div-free virtual element methods for fluid problems
- Nitsche technique in virtual element methods

**Dibyendu Adak** (Los Alamos National Laboratory, Nuevo Mexico, USA)
- Virtual element methods for eigenvalue problems
- Locking-free virtual element methods for elasticity
- Non-conforming virtual element methods for eigenvalue problems

**Gianmarco Manzini** (IMATI, Consiglio Nazionale delle Ricerche, Pavia, Italy)
- Virtual element method for biharmonic problems
- Non-conforming virtual element method for eigenvalue problems

**Franco Dassi** (Università Milano - Bicocca, Milán, Italy)
- C++ library for virtual elements
- Using VEM++ for solving source and eigenvalue problems
- Virtual element method for the 3D transmission eigenvalue problem

**Enrique Otárola** (Universidad Técnica Federico Santa María, Santiago, Chile)
- Finite element methods for eigenvalue problems in weighted Sobolev spaces

**Federico Fuentes** (Pontificia Universidad Católica de Chile, Santiago, Chile)
- Finite element method for the Stokes-Orr eigenvalue problem

**Gonzalo Rivera** (Universidad de Los Lagos, Osorno, Chile)
- Finite element method for solving eigenvalue problems

**Iván Velásquez** (Universidad Militar Nueva Granada, Bogotá, Colombia)
- Virtual element methods for the 3D transmission eigenvalue problem
- Coupling VEM-DG for eigenvalue problems

**David Mora** (Universidad del Bio-Bio, Concepción, Chile)
- Finite and virtual element methods for eigenvalue problems
- Nitsche method in finite and virtual element methods

**Felipe Lepe** (Universidad del Bío-Bío, Concepción, Chile)
- Finite element method for solving eigenvalue problems

**Pablo Venegas** (Universidad del Bío-Bío, Concepción, Chile)
- Adaptive finite element method for acoustic vibration problems

## Complementary academic formation

**VI Congreso Iberoamericano sobre Conocimiento Especializado del Profesor de Matemáticas** , *Congreso*, Pontificia Universidad Católica de Valparaíso, Valparaíso, November 8-10, 2023.

**Escuela de control y optimización ECOPT**, *Workshop*, Universidad Técnica Federico Santa María, Santiago, December 8-12, 2015.

**Enseñanza, aprendizaje y evaluación por competencias**, *Short course*, Colegio Británico de Cartagena, December 2013- January 2014.

**Review at Mechanics** , *Online course*, MITx - Massachusetts Institute of Technology Online, Cartagena, June 1, 2013 to September 30, 2013.
Autenticity: https://verify.edx.org/cert/03146a67088145f1a5eba280381d2b2f

**Estrategias Metodológicas de aula para el trabajo por competencia**, *Short course*, Colegio Británico de Cartagena, April 1, 2013.

**Análisis no lineal y ecuaciones diferenciales parciales** , *Workshop in Universidad Nacional de Colombia* , Bogotá, June 23-30, 2010.

**Inducción a procesos pedagógicos** , *Short course, SENA*, 40 hours, Neiva, July 19, 2010.
COD:SGCV20102414881

**Estrategias pedagógicas para el desarrollo del pensamiento**, *Short course, SENA*, 40 hours, Neiva, August 12, 2008 .
COD:SGCV2008723009

**Semillero de matemáticas B** , *Universidad de Cartagena*, 80 hours, Cartagena, November 27, 2003.

**Semillero de matemáticas A** , *Universidad de Cartagena*, 80 hours, Cartagena, July 4, 2003.

**Técnica de lectura integral y selectiva**, *Técnicas Americanas de Estudio*, Cartagena, November 29, 2002.

## Teaching Experience

### Undergraduate Teaching Experience

2016 – 2024 **Universidad Técnica Federíco Santa María**, *Santiago-Valparaíso, March 7, 2016 to July 11, 2024*, Inmediate boss : Michael Karkulik, Phone: +56223037000, Dedication: Part-time.

Teaching activities:

- MAT021, Complemento: March 7, 2016 - July 16, 2016.
- MAT022, Complemento: August 2, 2016 - December 9, 2016.
- MAT274, Análisis Numérico II: April 1, 2020 - August 14, 2020.
- MAT270, Análisis Numérico: August 31, 2020 - January 15, 2021.
- MAT021, Complemento: April 6, 2021 - August 4, 2021.
- MAT270, Análisis Numérico: April 6, 2021 - August 4, 2021.
- MAT274, Análisis Numérico II: April 6, 2021 - August 4, 2021.
- MAT270, Análisis Numérico: August 30, 2021 - January 20, 2022.
- MATE26, Cálculo Integral: March 07, 2022 - June 13, 2022.
- MATE11, Precálculo: March 11, 2024 - July 11, 2024.

2022 **Universidad del Bío-Bío**, *Concepción, March 14, 2022 to August 14, 2022*, Inmediate boss : David Mora, Phone: +56976169333, Dedication: Part-time.

Teaching activities:

- Cálculo Multivariable (220160): March 14, 2022 - August 14, 2022.
- Cálculo Integral (220146): March 14, 2022 - August 14, 2022.

2014–2015 **Fundación Universitaria Colombo Internacional-Unicolombo** , *Cartagena, August 4, 2014 to June 12, 2015*, Immediate boss: Angélica Herrera Castro, Phone: +5756725800 , Dedication: Part-time in 2014-II, Full-time in 2015-I.

Teaching activities:

- Differential Calculus: August 4, 2014 - November 29, 2014.
- Linear Algebra: August 4, 2014 - November 29, 2014.
- Differential Calculus: February 2, 2015 - June 12, 2015.
- Integral Calculus : February 2, 2015 - June 12, 2015.
- Vector Calculus: February 2, 2015 - June 12, 2015.

Advice:

- Advisor in the student stay and reinforcements in mathematics program: August 2, 2014 - June 12, 2015.
- Advisor and classroom-research referee in first, second and third semester in the Tecnología en Sistemas de Gestión de Calidad (Ingeniería Industrial) program: February 2, 2015 - June 12, 2015.

### Secondary Teaching Experience

2012–2014 **Colegio Británico de Cartagena (IB School)**, *Cartagena, January 09, 2012 to November 7, 2014*, Immediate boss : Adriana Torres, Phone : +576930982, Dedication: Full-time .

Positions:

- January 2012- June 2012: Math teacher at 7,8 and 9 grade.
- August 2012- June 2013: Math teacher at 9 grade and math (core) in 10 grade.
- August 2013 - June 2014: Math teacher in 9 grade, math (core) in 10 and 11 grade.
- August 2014 - November 2014 : Math teacher in 7, 8 and 9 grade. Advanced Math in 10 grade (Cambridge A-levels Math).

2011 **Colegio La Nueva Esperanza**, *Cartagena, January 25 to November 30*, Immediate boss : Maria Virginia Irisarri, Phone : +573157453986, Dedication: Full-time .

Position: Math and statistics teacher in 6,7 and 8 grade.

2010 **Concentración Educativa Coronel José Carmelo Villamizar Díaz**, *Cartagena, January 25 to November 25*, Immediate boss : Sandra Arrieta Marrugo, Phone : +573114183985, Dedication: Full-time.

Position: Math and informatic teacher in 10 and 11 grade.

## Teaching skills

As a specialist in numerical analysis, I firmly believe that the integration of computational tools into mathematics education is essential in today's society. With extensive experience in programming languages such as MATLAB, Python, and others, I am well-positioned to promote their use among undergraduate and graduate students. I aim to contribute to the enhancement of university programs by incorporating computational tools into the curriculum to better prepare students for modern challenges. I can work in teams with other professors to provide mathematical and computational ideas in the development of programs or to tackle mathematical problems of local, national, or international significance.

I will always be willing to discuss with my colleagues our ideas about teaching and learning mathematics in order to maximize the strengths and minimize the weaknesses that may arise in the training of my students according to what is established by the university.

Finally, I can develop academic curriculum that adapts to the vision of the university, without losing focus on the formation of high quality students. Multidisciplinarity is an essential component of this aspect, whereby the relationship between mathematics and other areas of science is considered as a common point for the development of activities.