Stéphanie Chaillat-Loseille

CNRS Research Director | Deputy Director of POEMS

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Research profile. A major objective of my work is to move beyond idealized model problems towards realistic wave propagation simulations, including heterogeneous media, multiple scattering, and coupled acoustic–elastic configurations. I combine expertise in mathematical analysis, numerical methods and high-performance scientific computing to advance computational mechanics, with applications ranging from seismic wave propagation to underwater acoustics and flow-induced noise, in collaboration with academic and industrial partners.
More recently, I have been exploring machine-learning and operator-learning approaches to accelerate large-scale wave simulations while preserving the structure and accuracy of classical numerical methods.

Current Positions and Major Responsibilities

2025– **Deputy Director, POEMS**, a joint CNRS–Inria–ENSTA research laboratory, Palaiseau, France.

2025– **Member, Open Science Advisory Board**, Institut Polytechnique de Paris.

2024– **Elected member, Board of Directors** (Conseil d'administration), Institut Polytechnique de Paris.

2024– **Vice-President**, French Association for Computational Structural Mechanics (CSMA).

2024– **Executive Board member**, International Association for Boundary Element Methods (IABEM).

2023– **CNRS Research Director** (Directrice de recherche), POEMS, ENSTA, Institut Polytechnique de Paris.

2023– **Editorial Board member**, *Journal of Theoretical, Computational and Applied Mechanics* (JTCAM).

2022– **Editorial Board member**, *Advances in Computational Mathematics* (ACOM).

2019– **Coordinator, Modeling and Simulation thematic group**, CNRS Research Network GDR Ondes.

Research Projects and Industrial Collaborations

My research programme combines mathematical analysis, numerical-method development and the in-house development of high-performance simulation codes, linking methodological advances to demanding applications through long-term academic and industrial partnerships. I have initiated or co-led projects spanning underwater acoustics, seismic-wave propagation, elastodynamics and biomechanics, and have used these collaborations to support doctoral and postdoctoral research.

Current scientific leadership

2024–2027 **ECOS-Sud Chile** – French co-lead. Multiple-trace and domain-decomposition methods for elastodynamic boundary integral equations; collaboration with C. Jerez-Hanckes, P. Escapil-Inchauspé and M. Darbas.

2025–2028 **ANR IM-SURF** – Scientific contributor and PhD co-supervisor. Impact and mitigation of seismic surface waves on large three-dimensional structures.

2022– **Sercel industrial partnership** – Scientific lead. Stable numerical methods for underwater-source and bubble-dynamics modelling.

2017– **Naval Group industrial partnership** – Co-lead of sustained research on underwater explosions and turbulent-flow noise, including several PhD projects.

Earlier Funding

2013–2025 **ANR DynImplant** (2022–2025); **ANR MODULATE** (2018–2022); **DGA postdoctoral fellowship** (2018); **EDF and Shell industrial PhD contracts** (2013–2016); **ANR RAFFINE** (2013–2016).

Supervision and Mentoring

Nine PhD students and four postdoctoral researchers formally supervised or co-supervised, together with four additional informal PhD mentoring roles.

Current PhD students

2025–2028 **Louis Auffret**, advanced fast BEM solvers for long-period seismic waves in realistic configurations; ANR IM-SURF; co-supervisor: J.-F. Semblat.

2024–2027 **Yahya Boye**, fast BEM for finite-geometry contact-mechanics problems; Mines Paris funding; co-supervisor: V. Yastrebov.

Completed PhD projects

2022–2025 **Louise Pacaut**, *tailored Green's functions for fluid–fluid and fluid–structure coupling, with application to flow-induced noise*; Naval Group funding; co-supervisor: J.-F. Mercier.

2020–2024 **Laura Bagur**, *fast BEM for fluid-injection effects in dynamic fault rupture*; ENS competitive fellowship; co-supervisors: J.-F. Semblat and I. Stefanou.

2020–2023 **Alice Nassor**, *time-domain domain decomposition for coupled acoustic–elastic problems and underwater explosions*; Naval Group funding; co-supervisor: M. Bonnet. **CSMA PhD Prize** and second prize, Maths & Entreprises.

2017–2020 **Damien Mavaleix-Marchessoux**, *Modelling fluid–structure coupling induced by a far-field underwater explosion*; Naval Group funding; co-supervisor: M. Bonnet.

2014–2018 **Zouhair Adnani**, *Three-dimensional numerical modelling of soil–structure interaction accounting for site effects*; EDF funding; co-supervisor: M. Bonnet.

2013–2017 **Luca Desiderio**, *$\mathcal{H}$-matrix-based solver for 3D elastodynamic boundary integral equations*; Shell funding; co-supervisor: P. Ciarlet.

2013–2016 **Marc Bakry**, *Reliability and optimisation of computations based on integral formulations for wave propagation*; ANR funding; co-supervision with P. Ciarlet and S. Pernet.

Additional informal PhD mentoring

2020–2026 **Elsie Cortes**, boundary integral equation methods for optical cloaking; PhD supervisors: Camille Carvalho and Chrysoula Tsogka, UC Merced.

2018–2021 **Nicolas Trafny**, semi-analytical prediction of broadband noise generated by turbulent-flow interaction with a complex rigid obstacle; PhD supervisors: Jean-François Mercier and Benjamin Cotté, ENSTA.

2014–2017 **Pierre Romanet**, fast algorithms for quasi-dynamic earthquake cycles in complex fault networks; PhD supervisor: Harsha Bhat, ENS Ulm.

2008–2011 **Eva Grasso**, fast-multipole BEM and FEM–BEM coupling for viscoelastic seismic-wave propagation; PhD supervisors: Marc Bonnet and Jean-François Semblat, Ecole Polytechnique.

Postdoctoral researchers

2015–2021 **Sara Touhami** (2020–2021); **Félix Kpadonou** (2017–2019); **Faisal Amlani** (2016–2018); **Samuel Groth** (2015–2016).

Scientific Leadership and Service

My service combines laboratory management, elected national responsibilities, scientific community leadership, editorial work and open-science engagement. These roles reflect regular solicitations at laboratory, institutional, national and international levels.

CNRS

2021–2023 Elected member, **CNRS Scientific Council**; Executive Committee member and Scientific Secretary.

2020–2021 Elected member, **CNRS National Committee, Section 9**.

2014–2018 Elected member, **CNRS Joint Administrative Committee for Researchers**.

Institut Polytechnique de Paris / ENSTA / POEMS

2024– Elected member, **Board of Directors**, Institut Polytechnique de Paris.

2025– Member, **Open Science Advisory Board**, Institut Polytechnique de Paris.

2020–2024 Elected member, **Academic Council**, Institut Polytechnique de Paris.

2025– **Deputy Director**, POEMS.

2016–2021 POEMS liaison officer for AMIES (Agency for Interaction in Mathematics with Business and Society).

2012–2018 Coordinator of the monthly POEMS research seminar.

National and international service

2024– **Vice-President**, French Association for Computational Structural Mechanics (CSMA).

2024– **Executive Board member**, International Association for Boundary Element Methods (IABEM).

2023– **Editorial Board member**, *Journal of Theoretical, Computational and Applied Mechanics* (diamond open access).

2022– **Editorial Board member**, *Advances in Computational Mathematics*.

2021– Member of the **CSMA PhD prize committee**.

2021 Member of the **ECCOMAS PhD prize committee**.

2019– Coordinator of the **Modeling and Simulation** thematic group of GDR Ondes.

2017– Member of the **CSMA scientific committee**.

2011– Reviewer for international journals in numerical analysis, computational mechanics, wave propagation, geophysics and applied mathematics.

Selected Distinctions and Invited Lectures

2026 **Plenary lecture**, Wave-Ned, Delft, The Netherlands.

2025 **Plenary lecture**, DD29, Milan, Italy; **semi-plenary lecture**, CFM, Metz, France.

2016 **Plenary lecture**, PDESoft, United Kingdom.

Invited research programmes: Institut Mittag-Leffler, Sweden (2025); Oberwolfach Workshop (2022, 2016); IPAM, UCLA (2017).

2009 **ECCOMAS PhD Prize**.

2009 **CSMA PhD Prize**.

Selected invited seminars abroad: Geophysics Department, UC Davis (2024); University of Arizona, Oden Institute at UT Austin, and Isaac Newton Institute for Mathematical Sciences, Cambridge (2023); Courant Institute, UC Merced, University of Colorado Boulder, and New Jersey Institute of Technology (2022); IUTAM Symposium, Waves Seminar at UC Merced, and Institute of Computational Mathematical and Scientific/Engineering Computing, China (2021); EPFL and California State University Northridge (2017).

Conference and Workshop Organisation

2027 Member of the Organizing Committee, **SIAM Conference on Computational Science and Engineering (CSE27)**, Pittsburgh, USA.

2022 Co-organiser, **WAVES 2022**, ENSTA Paris.

2018 Co-Chair, **IABEM 2018**, Paris.

2022 Co-organiser, BIRS Workshop "Outstanding Challenges in Computational Methods for Integral Equations" (competitively selected workshop proposal).

2020 Co-organiser, Oberwolfach Workshop "Boundary Element Methods" (competitively selected workshop proposal).

I have also co-organised additional scientific events, including conferences in honour of Patrick Ciarlet (2025) and Marc Bonnet (2022), the first Paris–London BEM Workshop (2017), and an ENSTA workshop on adaptive boundary element methods (2013).

Career

Academic appointments

2023– **CNRS Research Director** (DR2), POEMS, ENSTA, Institut Polytechnique de Paris, France.

2022–2024 **Adjunct Faculty**, Department of Geophysics, Stanford University, USA; collaboration with Eric Dunham.

2010–2023 **CNRS Research Scientist** (CR2, then CRCN), POEMS, ENSTA, France.

2009–2010 **Postdoctoral Associate**, Computational Science and Engineering Division, College of Computing, Georgia Institute of Technology, USA; host: George Biros.

Education and qualifications

2019 **Habilitation to Supervise Research (HDR)**, ENS Paris-Saclay.
Contributions to the modelling of acoustic and elastic wave propagation in large-scale domains with boundary element methods.

2008 **PhD in Mechanical Engineering**, École Polytechnique / École Nationale des Ponts et Chaussées.
Fast Multipole Method for boundary element method in 3D elastodynamics. Application to seismic wave propagation. Supervisors: Marc Bonnet and Jean-François Semblat.

2005 **Master's degree in Applied Mathematics**, ENS Lyon.

2005 **Engineering degree**, École Nationale des Travaux Publics de l'État; specialisation in advanced numerical methods for civil engineering.

Teaching

ENSTA Paris **Fast methods for boundary integral equations** (30h, Master's level, 2015–); earlier teaching in efficient FEM/BEM coupling, algorithms, Linux, finite elements and PDE discretisation.

ENTPE **Boundary Element Method** (6h, engineering curriculum, 2019–2024).

Doctoral teaching **Boundary Element Method** (6h, 2015–2021).

Selected Contributions

Ten publications representative of my main methodological contributions.

S. Chaillat, M. Darbas, P. Escapil-Inchauspé, C. Jerez-Hanckes. *Local Multiple Traces Formulation for Transmission Problems in Linear Elasticity*. *Computers & Mathematics with Applications*, 2026. A pedagogical presentation of the local multiple-trace formalism for elastodynamic transmission problems in layered homogeneous media.

M. Bonnet, S. Chaillat, A. Nassor. *A global-in-time domain decomposition approach for transient acoustic–elastic interaction*. *SIAM Journal on Scientific Computing*, 2026. A contribution to domain decomposition methods for transient fluid–structure interaction problems.

S. Chaillat, M. Darbas, M. J. Gander, L. Halpern. *Accelerating the Method of Reflections with Domain Decomposition techniques for Boundary Integral Equations in Multiple Scattering*. To appear in *BIT Numerical Mathematics*, 2026. Domain decomposition methods for wave problems formulated with boundary element methods.

S. Chaillat, B. Cotté, J.-F. Mercier, G. Serre, N. Trafny. *Efficient evaluation of three-dimensional Helmholtz Green's functions tailored to arbitrary rigid geometries for flow noise simulations*. *Journal of Computational Physics*, 2022. Model order reduction for boundary element methods through tailored Green's functions.

D. Mavaleix-Marchessoux, M. Bonnet, S. Chaillat, B. Leblé. *A fast boundary element method using the Z-transform and high-frequency approximations for large-scale 3D transient wave problems*. *International Journal for Numerical Methods in Engineering*, 2020. Fast time-domain boundary element method for large-scale transient waves.

S. Chaillat, S. Groth, A. Loseille. Metric-based anisotropic mesh adaptation for 3D acoustic boundary element methods. *Journal of Computational Physics*, 372, 473–499, 2018. An original mesh-adaptation method for boundary element methods, based on the continuous-mesh framework.

S. Chaillat, M. Darbas, F. Le Louër. *Fast iterative boundary element methods for high-frequency scattering problems in 3D elastodynamics*. *Journal of Computational Physics*, 341, 429–446, 2017. An analytical preconditioner for high-frequency elastodynamic boundary element methods.

S. Chaillat, L. Desiderio, P. Ciarlet. *Theory and implementation of $\mathcal{H}$-matrix based iterative and direct solvers for Helmholtz and elastodynamic oscillatory kernels*. *Journal of Computational Physics*, 351, 165–186, 2017. A discussion of the efficiency of algebraic $\mathcal{H}$-matrix solvers for wave problems.

S. Chaillat, M. Bonnet. *A new Fast Multipole formulation for the elastodynamic half-space Green's tensor*. *Journal of Computational Physics*, 2014. An original Fast Multipole Method for elastodynamic problems in elastic half-spaces.

S. Chaillat, M. Bonnet, J.-F. Semblat. *A multi-level fast multipole BEM for 3-D elastodynamics in the frequency domain*. *Computer Methods in Applied Mechanics and Engineering*, 2008. Foundational multi-level Fast Multipole accelerated BEM formulation for 3D elastodynamics.

Recent Publications and Manuscripts

Most recent publications and manuscripts, including work currently under review.

C. Carvalho, S. Chaillat, C. Tsogka, E. A. Cortes. Discretization in multilayered media with high contrasts: is it all about the boundaries? Manuscript under review, 2026.

L. Pacaut, S. Chaillat, J.-F. Mercier, G. Serre. Fluid-structure Green's functions via BEM/BEM coupling for flow induced noise in arbitrary elastic geometries. Manuscript under review, 2026.

S. Chaillat, M. Darbas, M. J. Gander, L. Halpern. Accelerating the Method of Reflections with Domain Decomposition techniques for Boundary Integral Equations in Multiple Scattering. To appear in *BIT Numerical Mathematics*, 2026.

M. Bonnet, S. Chaillat, A. Nassor. A global-in-time domain decomposition approach for transient acoustic–elastic interaction. *SIAM Journal on Scientific Computing*, 2026.

S. Chaillat, M. Darbas, P. Escapil-Inchauspé, C. Jerez-Hanckes. Local Multiple Traces Formulation for Transmission Problems in Linear Elasticity. *Computers & Mathematics with Applications*, 220, 293–321, 2026.

M. Almakari, N. Kheirdast, C. Villafuerte, M.-Y. Thomas, P. Dubernet et al.. Fault Volume Digital Twin to Reproduce the Full Slip Spectrum, Scaling, and Statistical Laws. *Journal of Geophysical Research: Solid Earth*, 2026.

S. Chaillat, M. Darbas, M. J. Gander, L. Halpern. Domain Decomposition for Integral Equations: Schwarz, Methods of Reflections and Elasticity. In *Domain Decomposition Methods in Science and Engineering XXIX*, 2026.

S. Chaillat. Fast Boundary Element Methods Beyond Homogeneous Media: Challenges Towards Realistic Wave Propagation Simulations. In *Domain Decomposition Methods in Science and Engineering XXIX*, 2026.

L. Pacaut, S. Chaillat, J.-F. Mercier, G. Serre. Efficient boundary integral method to evaluate the acoustic scattering from coupled fluid-fluid problems excited by multiple sources. *Journal of Computational Physics*, 2025.

P. Romanet, J.-P. Ampuero, F. Cappa, M. M. Scuderi, S. Chaillat. Combined Boundary Element and Finite Methods for Modeling Fluid-Induced Seismicity in Fault Networks within Low-Permeability Rocks. *Geophysical Journal International*, 2025.

Links

Personal webpage	https://perso.ensta.fr/~chaillat/
HAL CV	https://cv.hal.science/stephanie-chaillat
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IP Paris profile	Research Portal – Institut Polytechnique de Paris

Appendix: Full Publication List

Complete publication list, including current manuscripts. The up-to-date record is also available through HAL.

C. Carvalho, S. Chaillat, E. A. Cortes, C. Tsogka. Discretization in multilayered media with high contrasts: is it all about the boundaries? Manuscript under review, 2026.

L. Pacaut, S. Chaillat, J.-F. Mercier, G. Serre. Fluid-structure Green's functions via BEM/BEM coupling for flow induced noise in arbitrary elastic geometries. Manuscript under review, 2026.

M. Bonnet, S. Chaillat, A. Nassor. A global-in-time domain decomposition approach for transient acoustic–elastic interaction. To appear in *SIAM Journal on Scientific Computing*, 2026.

S. Chaillat, M. Darbas, M. J. Gander, L. Halpern. Accelerating the Method of Reflections with Domain Decomposition techniques for Boundary Integral Equations in Multiple Scattering. To appear in *BIT Numerical Mathematics*, 2026.

S. Chaillat, M. Darbas, P. Escapil-Inchauspé, C. Jerez-Hanckes. Local Multiple Traces Formulation for Transmission Problems in Linear Elasticity. *Computers & Mathematics with Applications*, 220, 293–321, 2026.

M. Almakari, N. Kheirdast, C. Villafuerte, M.-Y. Thomas, P. Dubernet et al.. Fault Volume Digital Twin to Reproduce the Full Slip Spectrum, Scaling, and Statistical Laws. *Journal of Geophysical Research: Solid Earth*, 131, e2025JB032915, 2026.

S. Chaillat, M. Darbas, M. J. Gander, L. Halpern. Domain Decomposition for Integral Equations: Schwarz, Methods of Reflections and Elasticity. In *Domain Decomposition Methods in Science and Engineering XXIX*, Springer-Verlag, 2026.

S. Chaillat. Fast Boundary Element Methods Beyond Homogeneous Media: Challenges Towards Realistic Wave Propagation Simulations. In *Domain Decomposition Methods in Science and Engineering XXIX*, Springer-Verlag, 2026.

L. Pacaut, S. Chaillat, J.-F. Mercier, G. Serre. Efficient boundary integral method to evaluate the acoustic scattering from coupled fluid-fluid problems excited by multiple sources. *Journal of Computational Physics*, 524, 113736, 2025.

P. Romanet, J.-P. Ampuero, F. Cappa, M. M. Scuderi, S. Chaillat. Combined Boundary Element and Finite Methods for Modeling Fluid-Induced Seismicity in Fault Networks within Low-Permeability Rocks. *Geophysical Journal International*, 243(3), ggaf377, 2025.

S. Chaillat, G. Gerardi, Y. Li, A. Chamolly, Z.-H. Li et al. The Sphericity Paradox and the Role of Hoop Stresses in Free Subduction on a Sphere. *Journal of Geophysical Research: Solid Earth*, 129(9), e2024JB029500, 2024.

M. Bonnet, S. Chaillat, A. Nassor. Solvability results for the transient acoustic scattering by an elastic obstacle. *Journal of Mathematical Analysis and Applications*, 536, 128198, 2024.

S. Chaillat, B. Cotté, J.-F. Mercier, G. Serre, N. Trafny. Efficient evaluation of three-dimensional Helmholtz Green's functions tailored to arbitrary rigid geometries for flow noise simulations. *Journal of Computational Physics*, 452, 110915, 2022.

L. Bagur, S. Chaillat, P. Ciarlet. Improvement of hierarchical matrices for 3D elastodynamic problems with a complex wavenumber. *Advances in Computational Mathematics*, 48, 2022.

S. Chaillat, M. Darbas, F. Le Louër. Analytical preconditioners for Neumann elastodynamic Boundary Element Methods. *SN Partial Differential Equations and Applications*, 2, 22, 2021.

D. Mavaleix-Marchessoux, M. Bonnet, S. Chaillat, B. Leblé. A fast boundary element method using the Z-transform and high-frequency approximations for large-scale 3D transient wave problems. *International Journal for Numerical Methods in Engineering*, 121, 4734–4767, 2020.

F. Ciardo, B. Lecampion, F. Fayard, S. Chaillat. A fast boundary element based solver for localized inelastic deformations. *International Journal for Numerical Methods in Engineering*, 121(24), 5696–5718, 2020.

F. D. Kpadonou, S. Chaillat, P. Ciarlet. On the efficiency of nested GMRES preconditioners for 3D acoustic and elastodynamic $\mathcal{H}$-matrix accelerated Boundary Element Methods. *Computers & Mathematics with Applications*, 80(3), 2020.

F. Amlani, S. Chaillat, A. Loseille. An efficient preconditioner for adaptive Fast Multipole accelerated Boundary Element Methods to model time-harmonic 3D wave propagation. *Computer Methods in Applied Mechanics and Engineering*, 352, 189–210, 2019.

S. Chaillat, S. Groth, A. Loseille. Metric-based anisotropic mesh adaptation for 3D acoustic boundary element methods. *Journal of Computational Physics*, 372, 473–499, 2018.

S. Chaillat, M. Darbas, F. Le Louër. Fast iterative boundary element methods for high-frequency scattering problems in 3D elastodynamics. *Journal of Computational Physics*, 341, 429–446, 2017.

S. Chaillat, L. Desiderio, P. Ciarlet. Theory and implementation of $\mathcal{H}$-matrix based iterative and direct solvers for Helmholtz and elastodynamic oscillatory kernels. *Journal of Computational Physics*, 351, 165–186, 2017.

K. C. Meza Fajardo, J.-F. Semblat, S. Chaillat, L. Lenti. Seismic Wave Amplification in 3D Alluvial Basins: 3D/1D Amplification Ratios from Fast Multipole BEM Simulations. *Bulletin of the Seismological Society of America*, 106(3), 1267–1281, 2016.

S. Chaillat, M. Darbas, F. Le Louër. Approximate local Dirichlet-to-Neumann map for three-dimensional time-harmonic elastic waves. *Computer Methods in Applied Mechanics and Engineering*, 297, 62–83, 2015.

S. Chaillat, F. Collino. A Wideband Fast Multipole Method for the Helmholtz Kernel: Theoretical Developments. *Computers & Mathematics with Applications*, 70, 660–678, 2015.

S. Chaillat, M. Bonnet. A new Fast Multipole formulation for the elastodynamic half-space Green's tensor. *Journal of Computational Physics*, 258, 787–808, 2014.

S. Chaillat, M. Bonnet. Recent advances on the fast multipole accelerated boundary element method for 3D time-harmonic elastodynamics. *Wave Motion*, 50, 1090–1104, 2013.

S. Chaillat, G. Biros. FaIMS: A fast algorithm for the inverse medium problem with multiple frequencies and multiple sources for the scalar Helmholtz equation. *Journal of Computational Physics*, 231, 4403–4421, 2012.

S. Chaillat, J.-F. Semblat, M. Bonnet. A preconditioned 3-D multi-region fast multipole solver for seismic wave propagation in complex geometries. *Communications in Computational Physics*, 11, 594–609, 2012.

E. Grasso, S. Chaillat, M. Bonnet, J.-F. Semblat. Application of the multi-level time-harmonic fast multipole BEM to 3-D visco-elastodynamics. *Engineering Analysis with Boundary Elements*, 36, 744–758, 2012.

S. Chaillat, M. Bonnet, J.-F. Semblat. A new fast multi-domain BEM to model seismic wave propagation and amplification in 3D geological structures. *Geophysical Journal International*, 177, 509–531, 2009.

S. Chaillat, M. Bonnet, J.-F. Semblat. A multi-level fast multipole BEM for 3-D elastodynamics in the frequency domain. *Computer Methods in Applied Mechanics and Engineering*, 197, 4233–4249, 2008.

S. Chaillat, H. D. Bui. Resolution of linear viscoelastic equations in the frequency domain using real Helmholtz boundary integral equations. *Comptes Rendus. Mécanique*, 335, 746–750, 2007.