

# Stanford

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## Omar Duran

Physical Science Research Scientist  
Energy Science & Engineering

### Bio

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#### BIO

I am a computational mathematician dedicated to solving complex real-world problems in geosciences. With a Ph.D. from the State University of Campinas (São Paulo, Brazil) and professional experience across Latin America, North America, and Europe, I specialize in the numerical simulation of physical systems.

At the core of my approach is a deep commitment to collaborative, reproducible science, using rigorous mathematics to build trustworthy simulation technology for a more sustainable energy future.

#### ACADEMIC APPOINTMENTS

- Physical Science Research Scientist, Energy Science & Engineering

### Research & Scholarship

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#### RESEARCH INTERESTS

- Math Education

#### CURRENT RESEARCH AND SCHOLARLY INTERESTS

Research at the intersection of computational math and subsurface poromechanics develops robust, structure-preserving, scalable methods for multiphysics in porous/fractured media. Focus: advanced discretizations (HHO, multiscale mixed FE), THM modeling with Cosserat effects, and compositional multiphase flow with phase changes. Work includes solver/preconditioner design, mixed-dimensional fracture modeling, and HPC software (GEOS) for near-exascale performance.

### Publications

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#### PUBLICATIONS

- **Mixed Finite Element Methods for Linear Cosserat Equations** *SIAM Journal on Numerical Analysis*  
Boon, W. M., Duran, O., Nordbotten, J. M.  
2025; 63: 306-333
- **Unified flash calculations with isenthalpic and isochoric constraints** *FLUID PHASE EQUILIBRIA*  
Lipovac, V., Duran, O., Keilegavlen, E., Radu, F. A., Berre, I.  
2024; 578
- **Exact sequences of conforming finite element spaces with interface constraints for macro polytopal meshes** *COMPUTERS & MATHEMATICS WITH APPLICATIONS*

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- Devloo, P. R. B., Duran, O., Gomes, S. M.  
2023; 134: 124-139
- **Evaluation of the impact of strain-dependent permeability on reservoir productivity using iterative coupled reservoir geomechanical modeling** *GEOMECHANICS AND GEOPHYSICS FOR GEO-ENERGY AND GEO-RESOURCES*  
Sanei, M., Duran, O., Devloo, P. R. B., Santos, E. S. R.  
2022; 8 (2)
  - **Unfitted hybrid high-order methods for the wave equation** *COMPUTER METHODS IN APPLIED MECHANICS AND ENGINEERING*  
Burman, E., Duran, O., Ern, A.  
2022; 389
  - **An Innovative Scheme to Make an Initial Guess for Iterative Optimization Methods to Calibrate Material Parameters of Strain-Hardening Elastoplastic Models** *ROCK MECHANICS AND ROCK ENGINEERING*  
Sanei, M., Devloo, P. R. B., Forti, T. L. D., Duran, O., Santos, E. S. R.  
2022; 55 (1): 399-421
  - **Hybrid High-Order Methods for the Acoustic Wave Equation in the Time Domain** *COMMUNICATIONS ON APPLIED MATHEMATICS AND COMPUTATION*  
Burman, E., Duran, O., Ern, A.  
2022; 4 (2): 597-633
  - **A multiscale mixed finite element method applied to the simulation of two-phase flows** *COMPUTER METHODS IN APPLIED MECHANICS AND ENGINEERING*  
Duran, O., Devloo, P. R. B., Gomes, S. M., Villegas, J.  
2021; 383
  - **Verification benchmarks for single-phase flow in three-dimensional fractured porous media** *ADVANCES IN WATER RESOURCES*  
Berre, I., Boon, W. M., Flemisch, B., Fumagalli, A., Glaeser, D., Keilegavlen, E., Scotti, A., Stefansson, I., Tatomir, A., Brenner, K., Burbulla, S., Devloo, P., Duran, et al  
2021; 147
  - **An innovative procedure to improve integration algorithm for modified Cam-Clay plasticity model** *COMPUTERS AND GEOTECHNICS*  
Sanei, M., Duran, O., Devloo, P. R. B., Santos, E. S. R.  
2020; 124
  - **An enhanced sequential fully implicit scheme for reservoir geomechanics** *COMPUTATIONAL GEOSCIENCES*  
Duran, O., Sanei, M., Devloo, P. R. B., Santos, E. S. R.  
2020; 24 (4): 1557-1587
  - **Stability analysis and uncertainty modeling of vertical and inclined wellbore drilling through heterogeneous field** *OIL AND GAS SCIENCE AND TECHNOLOGY-REVUE D IFP ENERGIES NOUVELLES*  
Batalha, N. A., Duran, O. Y., Devloo, P. R. B., Vieira Jr, L. C. M.  
2020; 75
  - **H(div) finite elements based on nonaffine meshes for 3D mixed formulations of flow problems with arbitrary high order accuracy of the divergence of the flux** *INTERNATIONAL JOURNAL FOR NUMERICAL METHODS IN ENGINEERING*  
Remy Bernard Devloo, P., Duran, O., Monteiro Farias, A., Maria Gomes, S.  
2020; 121 (13): 2896-2915
  - **High-order composite finite element exact sequences based on tetrahedral-hexahedral-prismatic-pyramidal partitions** *COMPUTER METHODS IN APPLIED MECHANICS AND ENGINEERING*  
Devloo, P. R. B., Duran, O., Gomes, S. M., Ainsworth, M.  
2019; 355: 952-975
  - **A multiscale hybrid method for Darcy's problems using mixed finite element local solvers** *COMPUTER METHODS IN APPLIED MECHANICS AND ENGINEERING*  
Duran, O., Devloo, P. R. B., Gomes, S. M., Valentin, F.  
2019; 354: 213-244
  - **An object-oriented framework for multiphysics problems combining different approximation spaces** *FINITE ELEMENTS IN ANALYSIS AND DESIGN*

Farias, A. M., Devloo, P. R. B., Gomes, S. M., Duran, O.  
2018; 151: 34-49

- **Mixed finite element approximations based on 3-D *hp*-adaptive curved meshes with two types of H(div)-conforming spaces** *INTERNATIONAL JOURNAL FOR NUMERICAL METHODS IN ENGINEERING*

Devloo, P. B., Duran, O., Gomes, S. M., Shauer, N.  
2018; 113 (7): 1045-1060

- **Hierarchical high order finite element bases for H(div) spaces based on curved meshes for two-dimensional regions or manifolds** *JOURNAL OF COMPUTATIONAL AND APPLIED MATHEMATICS*

Castro, D. A., Devloo, P. R. B., Farias, A. M., Gomes, S. M., Duran, O.  
2016; 301: 241-258

- **Three dimensional hierarchical mixed finite element approximations with enhanced primal variable accuracy** *COMPUTER METHODS IN APPLIED MECHANICS AND ENGINEERING*

Castro, D. A., Devloo, P. R. B., Farias, A. M., Gomes, S. M., de Siqueira, D., Duran, O.  
2016; 306: 479-502