

Nicolas Gourdain
ISAE-Supaero
University of Toulouse
10 avenue Edouard Belin
31055 Toulouse - FRANCE

Professor in fluid mechanics
Born in Paris, 7 April 1979
Phone (professional): +33 (0)5 61 33 92 55
nicolas.gourdain@isae.fr

Research objectives: current activities involve the development and validation of numerical methods for multi-physics applications (aero-elasticity) and high-fidelity simulations of turbulent flows, applied to flows at high Reynolds numbers (aircraft, turbomachinery and flow control). The research objectives are to develop numerical methods (e.g. Large-Eddy Simulation, Lattice-Boltzmann Method) for complex geometries and to investigate efficient propulsive systems integrated within the airframe.

Main skills

- ⇒ Aerodynamics and flow control
- ⇒ Turbulent flow simulations (RANS/LES)
- ⇒ High performance computing
- ⇒ Management and PhD supervision

Work experience

- **ISAE - Supaero (Toulouse, France)**
2013 – Full Professor in fluid mechanics at the Dpt. of Aerodynamics, Energetic and Propulsion of ISAE-Supaero (University of Toulouse, France). Main activities: CFD, aircraft, flow control, teaching and supervision of trainees and PhD students.
- **CERFACS (Toulouse, France)**
2006 - 2013 Postdoctoral fellow then senior researcher in the **Computational Fluid Dynamics** team. Leader of the “turbomachinery” team since 2009 (10 people). Main activities: high-performance computing, CFD in compressors and turbines, contract management and supervision.
- **ONERA (Châtillon, France)**
Nov. 2002-Oct. 2005 PhD at the **Applied Aerodynamics Dpt.** under the supervision of Pr. Leboeuf (Ecole Centrale of Lyon, France) and Mr. Burguburu (ONERA). Subject: “Numerical Simulation of Rotating Stall in an Axial Compressor”.
- **LMFA (UMR CNRS 5509) (Ecole Centrale Lyon, France)**
Nov. 2001-Juil. 2002 Training in the **Turbomachinery team**. Subject: “Numerical Simulation of Unsteady Flows in an Aerospace Turbo-Pump”, in the frame of the European project HPNURSA.

Education

- **HDR**, Habilitation to Conduct Research (Nov. 2011) Ecole Centrale of Lyon, Ecully (France)
- **Ph.D.**, 2002-2005 (defended Oct. 19, 2005) Ecole Centrale of Lyon, Ecully (France)
- **Master of sciences** in thermic & energetics, 2001-2002 Ecole Centrale of Lyon, Ecully (France)
- **Master’s degree in Mechanical Engineering**, 1997-2001 University of Poitiers (France)

Main collaborations

- University of Stanford (USA), University of Cambridge (UK), Von Karman Institute, Fluid Mechanics and Acoustic Lab. (Ecole Centrale Lyon), ONERA (France), SAFRAN, AIRBUS (Civil Aircraft and Helicopter), CNES (French National Space Center)

Supervision and publications

Supervision of past PhD students

- Dr. Guillaume Legras, (2008-2011), PhD on turbomachinery and flow control, now working at Airbus Helicopter
- Dr. Elena Collado, (2009-2012), PhD on turbomachinery and aerothermal, winner of the “Léopold Escande” prize in 2012 (best PhD of the University of Toulouse), now working at SAFRAN-Turbomeca

- Dr. Fabien Wlassow, (2009-2012), PhD on turbomachinery and aerothermal, now working at Airbus Civil Aircraft
- Dr. Flore Crevel, (2010-2013), PhD on surge in turbomachinery, winner of the “Paul Caseau” prize (funded by EDF), now working at BoostHEAT

Supervision of current PhD students

- Gaele Mouret, (2013-), funded by SAFRAN-Snecma, PhD on turbulence for turbomachinery
- Majd Daroukh, (2014-), funded by SAFRAN-Snecma, PhD on aero-acoustics for turbomachinery
- Alessandro Fiumara, (2014-), funded by Assystem, PhD on flow control of wing sails
- Morgane Marino, (2013-), funded by Airbus Helicopter, PhD on numerical simulation for turbomachinery
- Elisa Bosco, (2014-), funded by Airbus Civil Aircraft, PhD on aero-elasticity for aircraft
- Benjamin Godard, (2015-), funded by SAFRAN-Snecma, PhD on turbofan integration
- Jérôme Dumon, (2015-), funded by CNES, PhD on aero-elasticity for space launchers

Publications in peer-reviewed journals

- L. Castillon, N. Gourdain, and X. Ottavy. (2015). Multiple-Frequency Phase-Lagged Unsteady Simulations of Experimental Axial Compressor, *Journal of Propulsion and Power*, 31
- N. Gourdain. (2015). Prediction of the unsteady turbulent flow in an axial compressor stage. Part 1: Comparison of unsteady RANS and LES with experiments. *Computers and Fluids*, 106
- N. Gourdain. (2015). Prediction of the unsteady turbulent flow in an axial compressor stage. Part 2: Analysis of unsteady RANS and LES data *Computers and Fluids*, 106
- F. Crevel, N. Gourdain, S. Moreau. (2014). Numerical Simulation of Aerodynamic Instabilities in a Multistage High-Speed High-Pressure Compressor on Its Test-Rig Part I: Rotating Stall, *Journal of Turbomachinery*, 136
- F. Crevel, N. Gourdain, X. Ottavy. (2014). Numerical Simulation of Aerodynamic Instabilities in a Multistage High-Speed High-Pressure Compressor on Its Test Rig Part II: Deep Surge, *J. Turbomachinery*, 136
- N. Gourdain, F. Sicot, F. Duchaine, L. Gicquel. (2014). Large eddy simulation of flows in industrial compressors: a path from 2015 to 2035, *Phil. Trans. R. Soc. A*, 372
- T. Leonard, L. Gicquel, N. Gourdain, F. Duchaine. (2014). Steady/unsteady reynolds averaged navier-stokes and large eddy simulations of turbine blade at high subsonic outlet mach number. *J. of Turbomachinery*, 137
- Ottavy, X., Courtiade, N. and Gourdain, N. (2012). Investigations of the Flow in a High-Speed 3.5-stage compressor: methods and comparison of experimental and numerical database, *AIAA J. of Propulsion and Power*, 28(6), pp. 1141-1155
- E. Collado, N. Gourdain, F. Duchaine, and L.Y.M. Gicquel. (2012). Effects of free-stream turbulence on high-pressure turbine blade heat transfer predicted by structured and unstructured LES. *Journal of Heat and Mass Transfer*, 55(21-22):5754- 5768
- N. Courtiade, X. Ottavy, and N. Gourdain. (2012). Modal decomposition for the analysis of the rotor-stator interactions in multistage compressors. *Journal of Thermal Science*, 21(3):276-285
- Gourdain, N., Gicquel, L. and Collado, E. (2012). Comparison of RANS and LES for the prediction of the wall heat transfer in a highly loaded turbine guide vane. *AIAA J. of Propulsion and Power*, 28(2), pp.423-433
- Legras, G., Trebinjac, I., Gourdain, N., Ottavy, X. and Castillon, L. (2012). A Novel Approach to Evaluate the Benefits of Casing Treatment in Axial Compressors. *Int. J. Rotating Machinery*
- Sicot, F., Dufour, G. and Gourdain, N. (2012). A Time-Domain Harmonic Balance Method for Rotor/Stator Interaction. *J. of Turbomachinery*, 134(1)
- Gourdain, N., Ottavy X. and Wlassow, F. (2012). Effect of Tip Clearance Dimensions and Control of Unsteady Flows in a Multistage High-Pressure Compressor. *J. of Turbomachinery*, 134(5)
- Gicquel, L., Gourdain, N., Boussuge, J.-F., Deniau, H., Staffebach, G., Wolf, P. and Poinot, T. (2011). High Performance Parallel Computing of Flows in Complex Geometries, *CRAS*, 339(2)
- Gourdain, N., Montagnac, M., Wlassow, F. and Gazaix, M. (2010). High Performance Computing to Simulate Large Scale Industrial Flows in Multistage Compressors. *The International J. of High Performance Computing Applications*, 24(4)

- Gourdain, N., Burguburu, S., Leboeuf, F. and Michon, G-J. (2010). Simulation of Rotating Stall in a Whole Stage of an Axial Compressor. *J. of Computer and Fluids*, 39(9)
- Legras, G., Gourdain, N. and Trebinjac, I. (2010). Numerical Analysis of the Tip Leakage Flow Field in a Transonic Axial Compressor with Circumferential Casing Treatment. *J. of Thermal Science*, 19(3)
- Gourdain, N., Gicquel, L., Montagnac, M., Vermorel, O., Gazaix, M., Staffelbach, G., Garcia, M., Boussuge, J-F. and Poinso, T. (2009). High Performance Parallel Computing of Flows in Complex Geometries - Part 1 : Methods. *J. of Computational Science and Discovery*, 2(015003)
- Gourdain, N., Gicquel, L., Staffelbach, G., Vermorel, O., Duchaine, F., Boussuge, J-F. and Poinso, T. (2009). High Performance Parallel Computing of Flows in Complex Geometries - Part 2: Applications. *J. of Computational Science and Discovery*, 2(015004)
- Gourdain, N. and Leboeuf, F. (2009). Unsteady Simulation of an Axial Compressor Stage with Casing and Blade Passive Treatments. *J. of Turbomachinery*, 130(2)
- Gourdain, N., Burguburu, S., Leboeuf, F. and Miton, H. (2006). Numerical Simulation of Rotating Stall in a Subsonic Compressor. *J. of Aerospace Science and Technology*, 10(1)

Invited lectures

- N. Gourdain. High Performance Computing of gas turbine flows : current and future trends. PRACE meeting, University of Ljubljana, Slovenia, September 2013
- Gourdain N., Boussuge J.-F., Crevel F., Daviller G., Gicquel L.Y.M., and Sicot F. High-performance computing and CFD: the state-of-the-art technology for jet engine simulations -. In *CEAS 2013 Air and Space Conference, Innovative Europe*, Linkoping, Sweden, September, 16th, 2013
- N. Gourdain. Cutting-edge simulations for turbomachinery flows. Keynote lecture, CFD Canada, Sherbrooke, Montreal, May, 2013
- L.Y.M. Gicquel, S. Moreau, G. Staffelbach, O. Vermorel, A. Dauptain, N. Gourdain, E. Collado, J-C. Giret, T. Poinso. Compressible LES for Airframe Noise. VKI Lecture Series, "Accurate and Efficient Aero-acoustic Prediction Approaches for Airframe Noise", March 25th 28th , Rhodes-St-Genese, Belgium, 2013
- L.Y.M. Gicquel, B. Cuenot, G. Staffelbach, O. Vermorel, E. Riber, A. Dauptain, F. Duchaine, N. Gourdain, F. Sicot, and T. Poinso. CERFACS state-of-the-art and recent investigations for temperature predictions in turbo-machineries - invited conference. In *Conference on High Fidelity Simulations of Combustion Turbine Systems*, GE RC Niskayuna, NY, USA, June 25-26 2012
- L.Y.M. Gicquel, E. Collado, J. Amaya, N. Gourdain, and T. Poinso. Multi-components and multi-physics CFD simulation for the predictions of gas turbine - invited conference. In *ECCOMAS*, Lisbon, Portugal, June 14-17 2010
- L.Y.M. Gicquel, B. Cuenot, G. Staffelbach, E. Riber, A. Dauptain, N. Gourdain, M. Montagnac, J.-F. Boussuge, M. Gazaix, and T. Poinso. High performance computing of industrial flows : Application to aeronautic and propulsion challenges - invited conference. In *1st Workshop on Complex Fluid Dynamics*, Kaust campus, Saudi Arabia, March 22-25 2010
- Leboeuf, F., Trebinjac, I., Ottavy, X. and Gourdain, N. Aerodynamics Studies in High-Speed Compressors Dedicated to Aeronautical Applications. *27th International Congress of the Aeronautic Sciences*, Nice, France, Sept. 2010
- Gourdain, N., Gicquel, L., Montagnac, M., Vermorel, O., Gazaix, M., Staffelbach, G., Garcia, M., Boussuge, J-F., and Poinso, T. High Performance Computing of Industrial Flows : Application to Aeronautic and Propulsion Challenges, VKI Lecture Series on High Performance Computing of Industrial Flows, Rhodes-St-Genese, Belgium, May 5-7, 2009
- Dufour, G., Gourdain, N., Duchaine, F., Vermorel, O., Gicquel, L., Boussuge, J-F., and Poinso, T., Large Eddy Simulation Applications. VKI Lecture Series Numerical Investigations in Turbomachinery : the State of the Art, Rhodes-St-Genese, Sept. 21-25, 2009
- Poinso, T. and Gourdain, N. Large Eddy Simulation of Turbulent Flows by Means of Massively Parallel Computing platforms. ONERA Scienti_c Day, Oct., 2009