Pierre Del Moral
Date of birth: January 7th, 1965 (Nationality: French).
Married with two children: Timothy (1989), and Tiffany (1993).
Languages (fluent): French, English, Spanish.

& **INRIA Senior Research Scientist/Research Director**
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Education

- Higher Degree of Research, (H.D.R.) in Math., U.P.S. Toulouse III (2002).
- Ph. D. Signal processing LAAS-CNRS & P. Sabatier Univ., Toulouse (1994).
- Master of Science, theory track, P. Sabatier Univ., Toulouse (1989).
  Pure Mathematics (Cohomology, Hyperbolic Geometry & Algebraic Geometry).
  (Grade: Ist class Honors).

Research interests

- Applied probability, stochastic algorithms and mean field particle methods.
- Simulation & Monte Carlo methods in physics and engineering sciences.
- Branching and interacting particle systems, genealogical tree based models.
- Reinforced processes and self interacting Markov chain models.
- Fluctuation analysis, large deviations and convergence of empirical processes.
- Feynman-Kac-Schrödinger semigroups and their application areas : nonlinear filtering, Bayesian inference, stochastic optimisation, rare event analysis, molecular chemistry, computational biology, financial mathematics.

Professional history

Start	End	Institutions	Positions and status
Sept. 1991	Sept. 1992	DIGILOG-STERIA	Research Engineer
Sept. 1993	Sept. 1995	DIGILOG-STERIA	Research Engineer
Sept. 1994	Sept. 1995	ENSAE-Sup AERO (Toulouse)	Lecturer (Part time)
Sept. 1995	Sept. 2004	CNRS (Toulouse)	Chargé de Recherche (CR2, CR1-1998, Math-Physics Sec.)
Sept. 2004	Sept. 2007	Université de Nice	Professor PR2 (Mathématiques)
Sept. 2007	Jan. 2014	INRIA (Bordeaux)	Directeur de Recherches (DR2 and DR1 since 2011)
Sept. 2011	Jan. 2014	Polytechnique CMAP	Professeur chargé de cours (Part-time)
Jan. 2014	Jan. 2016	UNSW Sydney	Professor (School of Mathematics - INRIA secondment)
Oct. 2018	Oct. 2019	Polytechnique CMAP	Scientific collaborator (E. Gobet - Stress Test Chair)
Jan. 2016	...	INRIA (Bordeaux)	Directeur de Recherches (DR1)

International invited positions

Start	End	Institutions	Positions and status
Jan. 1995	March 1995	Russian Acad. of Sci.	Invited Researcher (Institute for Problems in Mechanics)
Sept. 2001	Dec. 2001	Princeton University	Invited Professor (ORFE Department)
July. 2002	Aug. 2002	Melbourne University	Invited Professor (Electrical Eng. Dept.)
Dec. 2002	Sept. 2003	Purdue University	Invited Professor (Mathematics Department)
July. 2013	Aug. 2013	CSIRO Sydney	Invited Senior Researcher
Oct. 2016	Nov. 2016	Imperial College	Invited Professor
Sep. 2017	Oct. 2017	HEC (Montréal)	Simons CRM Invited Professor
Feb. 2018	March 2018	FGV (Rio, Brasil)	Invited Professor
Sep. 2022	Oct. 2022	Bristol University	Heilbronn Invited Professor

Around 200 seminars and conferences; [link to invited-conferences], to name a few:

- Medallion lecturer - World Congress in Probability and Statistics. `Fields Institute Toronto (2016)`.
- Plenary lecture. MCQMC 2012, International Conf. on Monte Carlo and QMC Methods, Sydney Australia (2012).
- Plenary lecture. Stochastic Processes and their Applications, Melbourne (July 2002).
- Plenary lecture, Journées MAS Clermont-Ferrand (August 2012).
- Colloquium lectures: Heilbronn Colloquium, Bristol (September 2022), Maxwell Institute Colloquium Edinburgh, Bayes Center, (October 2019), Maxwell Colloqium.University of Edinburgh, Scotland, (February 2015), Colloque a l'Assemblee generale du departement MIA (Mathematique et Informatique Appliquees), INRA Agde meeting (October 2005), Centre de Mathématiques et leurs Applications, E.N.S. Cachan (May 2004), Colloquium Department of Mathematical Sciences University of Alberta, Edmonton (April 1999).

Research-team managements

- Head of the INRIA project-team ALEA in Bordeaux (2009-2013). The team was made up of 5 permanent staff, 2 research engineers, 3 external members. We performed a dozen contracts and industrial collaborations with DCNS-SIS, SAGEM, EDF, CEA, EDF (ICAME and OSIRIS), IFREMER, DASSAULT-AVIATION. We also developed 2 softwares, the first one on an ADT INRIA (Software Biips), the second is classified and concerns the realization of a passive radar multi-target filtering demonstrator with Thales & DCNS-SIS.

- Head of the 2AS INRIA-associated-team between the INRIA-team project ALEA and the Maths Dept. of Wuhan Univ. in China (Prof. Wu Li Ming) in 2009.

- Head of the Proba-Stats team of the Bordeaux Maths Institute in 2009-2010. cf. the AERES Evaluation report.

Research-project managements

- Head of the INTAS-RFBR, European Program on Idempotent Analysis in Paul Sabatier Univ. with V.P. Maslov, Russian Academy of Sciences (1996-1999); Head of the CNRS-Research Program on Particle Methods for Non Linear Filtering in Paul Sabatier University, Toulouse (1998-2001).

- Head of the research project Stochastic Modeling and Bayesian Inference for the Epidemiology of Multi-Strain Communicable Diseases. PEPII projet 2011 ("Projets exploratoires pluridisciplinaires inter-instituts" INSB-INEE-INSMI-INS2I) between the Bordeaux Maths Inst. and the Ecology & Evolution Lab., UMR 7625 CNRS-UMPC-ENS Paris, joint project `with Bernard Cazelles`.

- Head of the ARC INRIA EPS 2009-2011, joint project with INRA Jouy-en-Josas (J.P. Gauchi) & Montpellier (J.P. Vila), École vétérinaire d'Alfort and the LUBEM Quimper). Development of the matlab-software FILTREX (presented at the "Journées Nationales des ARC-ADT-Actions exploratoires", at INRIA Paris-Rocquencourt, december 2010).

- Head of a regional project of the Aquitaine Regional Council in INRIA Bordeaux on Monte Carlo methods by interacting Markov chains (2008-2009).

- Head of a methodological research project between Nice-Sophia Antipolis Univ. and the INRA dpt. MIA 2006. "Statistical approaches to microbiology dynamical systems with applications to food risk". Joint project with INRA Jouy-en-Josas (J.P. Gauchi) & Montpellier (J.P. Vila).

- Head of the CNRS Maths-STIC research project Particle methods and analysis of hidden Markov chains (2002-2003), between the Stats and Proba. Lab. LSP-Toulouse, the INRIA team of F. Le Gland in Rennes, and E. Moulines at Sup Telecom Paris; Head of the CNRS-section 01 research project in the Laboratory of Statistics and Probabilities of Toulouse, on particle methods and nonlinear filtering (1998-2001).

Research-project member

- Since 2023, member of the MaThRad Advisory Board, PI of the project A. Kyprianou.
- Member of the ARN Quamproc, head of the ANR L. Michel (2019-2023).
- Member of the Australian ARC/Linkage Project 17 : Remote sensing to improve structural efficiency of high-speed catamarans (head of the project J. Lavroff and S. Penev Principal investigator UNSW) (2018).
- Member of the ARC INRIA RARE (2005-2007).
- Member of the International cooperation program between the INRIA team-projects ARMOR, ASPI & the GERAD, Montreal Univ. and Montreal HEC (2005-2007).
- Member of the MITACS Network on Prediction in Interacting Systems (1999-2005).
- Member of the TMR Network on Stochastic Analysis and Applications, head of the project T. Lyons (1996-2001).
- Member of the ANR VIROSCOPY, head of the ANR S. Clémençon (2010-2013).
- Member of the l'ANR PROPAGATION between the INRIA project-team ALEA in Bordeaux, DCNS-SIS, THALES (head of the ANR Fr. Caron) (2009-2012).
- Membre of the ANR PREVASSEMBLE with the ENS Paris (head of the ANR, O. Talagrand) & Météo France Toulouse (C. Baehr) (2008-2011).
- Scientific coordinator of the ANR Chaire d'Excellence 2006, for the visit of P. Diaconis in Nice University.
- Member of the ANR MODECOL, between the CNRS, La Rochelle Univ. and INRIA (head of the ANR, C. Mony) (2009-2012).
- Member of the ANR NEBBIANO between the CNRS, Nice-Sophia Antipolis Univ., and INRIA (head of the ANR, T. Furon) (2007-2010).

Editorial boards

- Annals of Applied Probability, AE since 2019.
- Foundations of Data Science, AE since 2018.
- Stochastic Analysis and Applications, AE since 2001.
- Co-editor-in-Chief of ESAIM: Proceedings from 2006-2011 with J. F. Gerbeau & E. Cancès; Applied Mathematics and Optimization AE 2009-2013; Revista de Matemàtica: Teoria y Aplicaciones AE 2009-2018; ESAIM M2AN with Nicolas Hadjiconstantinou special volume in 2010 on Probabilistic methods in scientific computing and numerical analysis. (see article An introduction to probabilistic methods); Stochastic Processes and their Applications AE 2006-2009.

Teaching/Lectures

- (2014-2016): UNSW Sydney Australia, 2 courses on stochastic processes (MATH5835) & Advanced Monte Carlo methods (MATH5805) (72h/year).
- (2011-2014) : Professeur chargé de cours Polytechnique, CMAP (58h/year); (2007-2011) : Bordeaux Univ., Simulation et Algo. stochastiques, Master I & II Mathématiques & Master MIMSE. Course and tutorials (66h).
- (2011) Post-Graduate Course : CSC Doctorate School, Luxembourg University. Evolutionary particle methods: an introduction with applications (12h); (2009) Post-graduate course on stochastic algo. (November), La Havana Univ.
- (2004-2007) Nice, Sophia-Antipolis Univ. (185h/year):
  Integration, probability and statistics (Master I Math) Course and tutorials; Financial Maths. (L3 Mass, et École Polytechnique Universitaire Nice-Sophia Antipolis), Course and tutorials; Stochastic Engineering (Master 2 MASS), Course and tutorials; Dynamical systems, (L3 MASS) tutorials.
- (2000-2001) Princeton University + (2003-2004) Paul Sabatier Univ. Toulouse + (2018) Fundação Getulio Vargas Rio + (2021) Vega Institute Foundation, Moscow State University (Zoom-online): 4 post-graduate courses on Feynman-Kac formulae and their mean field interpretations (30h/course); (2002-2003) Purdue University: Introduction to probab. 3rd and 4th year univ. (60h).
- (1996-2002) : Paul Sabatier Univ. Toulouse. Simulation & Stochastic Algorithms. DESS & INSA (30h/year); (1994-1995): Ecole Nationale Supérieure de l'Aéronautique et de l'Espace, Toulouse; 2 tutorials on Harmonic analysis, Stats-Proba. and Markov chains (30h/tutorial).
- ICCAIS 2022 tutorial on Ensemble Kalman and Particle filters. Hanoi, Vietnam (November 2022) (3h); Summer School, Institute for Advanced studies in mathematics of Harbin China, (Zoom-online) Series of lectures on advanced Monte Carlo methods (July 2021) (6h); Greek Stochastics meeting, Corfu, Greece (August 2019) (4h).
- Mini-course on particle methods: University of Edinburgh, Scotland, (February 2015) (4h) + Summer School Proba & Stats. Ho Chi Minh City Vietnam (July 2014) (4h)+ CIRM Luminy (March 2013) (6h) + Academy of Mathematics and Systems Science, Summer School Probability Beijing, China (July 2013) (6h) + CNRS-INLN Sophia-Antipolis, (Dec. 2012) (10h) + Summer School ENS Lyon Centre Blaise Pascal ENS Lyon (June 2012) (6h).
- Sino-French Summer Institute 2011. On the concentration of interacting particle processes. Academy of Science Beijing, China (June 2011) (6h); 10th Machine Learning summer school, An introduction to particle methods in stochastic engineeing. Ile de Ré, France (September 2008) (6h).
- The 24th Finnish Summer School on Probability Theory. Interacting Particle Approximations of Feynman-Kac Formulae with Applications. Lahti, Academy of Finland through the Rolf Nevanlinna institute (June 2002) (6h).

Industrial transfers

RADAR /SONAR/ GPS signal-processing

This technology transfers started in the early 1990s, during my PhD funded by the "Direction des recherches et études techniques (DRET)", then as a research engineer in DIGILOG-STERIA. These studies led to the development of the first particle filters for estimation and nonlinear control. This work was carried out in collaboration with G. Salut's team at LAAS-CNRS in Toulouse under industrial contracts with STCAN in Toulon, the company DIGILOG-STERIA and the DRET on nonlinear filtering and RADAR, SONAR and GPS tracking.

1. Estimation et commande optimale non-linéaire : un cadre unifié pour la résolution particulaire. P. Del Moral, G. Rigal, and G. Salut. LAAS-CNRS, Toulouse, Report no. 91137, DRET-DIGILOG- LAAS/CNRS contract, April 1991.

2. Estimation et commande optimale non-linéaire : La résolution particulaire en estimation, filtrage. P. Del Moral, G. Rigal, and G. Salut. Compléments de filtrage, commande optimale, et maximum de vraisemblance. Convention DRET no. 89.34.553.00.470.75.01, Rapport intermédiaire, no.4 (210p.), January (1993).

3. Estimation et commande optimale non-linéaire : La résolution particulaire en estimation filtrage. P. Del Moral, G. Rigal, and G. Salut. Résultats théoriques. Convention DRET no. 89.34.553.00.470.75.01, Rapport intermédiaire, no.3 (123p.), October (1992).

4. Estimation et commande optimale non-linéaire : La résolution particulaire en estimation filtrage. P. Del Moral, G. Rigal, and G. Salut. Résultats expérimentaux. Convention DRET no. 89.34.553.00.470.75.01, Rapport intermédiaire, no.2 (54p.), January (1992).

5. Traitement particulaire du signal radar : détection, estimation et reconnaissance de cibles aériennes. P. Del Moral, J.C. Noyer, G. Rigal, and G. Salut. LAAS-CNRS, Toulouse, Report no. 92495, December (1992).

6. Filtrage non-linéaire non-gaussien appliqué au recalage de plates-formes inertielles : Mise en équations spécifique. P. Del Moral, G. Rigal, and G. Salut. LAAS-CNRS, Toulouse, Report no. 92207, STCAN/DIGILOG-LAAS/CNRS Convention STCAN no. A.91.77.013, Rapport intermédiaire (94p.) September (1991).

Multi-target filtering and tracking

This technological transfer on stochastic filtering started with an first industrial contract between the INRIA team ALEA and the DCNS-SIS in Toulon in 2009, and was followed by the ANR PROPAGATION (ANR-09-SECU-0007) between the INRIA team ALEA and the industrial partners THALES ALIENA SPACE FRANCE, ECOMER (Ecology and conservation science for sustainable seas), EXAVISION and DCNS-SIS/Naval Group.

1. F. Caron, P. Del Moral and M. Pace. Etude des filtres particulaires PHD. Rapport de contrat no. 2009-DCNS-01 avec DCNS-SIS/Naval Group (2009).

2. Mean-field PHD filters based on generalized Feynman-Kac flow. M. Pace & P. Del Moral. IEEE Journal of Selected Topics in Signal Processing. vol. 7, no. 3, pp. 484-495 (2013).

   [link to article & DOI: 10.1109/JSTSP.2013.2250909]

3. Comparison of implementations of Gaussian mixture PHD filters. M. Pace, P. Del Moral & F. Caron. FUSION 2010. 13th International Conference on Information. FUSION, EICC, Edinburgh (2010).

   [link to article DOI: 10.1109/ICIF.2010.5711953]

Antenna array configuration optimization problems

This technological transfer on stochastic algorithms innovations concerns an industrial contract between the INRIA team ALEA and the CEA-CESTA (Pierre Minvielle). The contract report and the series of article related to this industrial transfer are listed below:

1. F. Caron, P. Del Moral, Fr. Giraud, and M. Pace Méthodes stochastiques pour l'optimisation globale sous contraintes [95p.], Contrat Recherche & Développement CEA-INRIA, Rapport de contrat no. 2009-CEA-01 (2009).

2. Advanced Interacting Sequential Monte Carlo Sampling for Inverse Scattering. F. Giraud, P. Minvielle & P. Del Moral. **IOP Inverse Problems**. vol. 29, no. 9 (2013).

   [link to article & DOI: 10.1088/0266-5611/29/9/095014]

3. Rao-Blackwellised Interacting Markov Chain Monte Carlo for Electromagnetic Scattering Inversion. F. Giraud, P Minvielle, M Sancandi & P Del Moral. Journal of Physics. Conf. Series 386, n. 1 (2012).

   [link to article & DOI: 10.1088/1742-6596/386/1/012008]

Deconvolution of signals by advanced Bayesian and Monte Carlo methods

This technological transfer concerns an industrial contract between the INRIA team ALEA and the CEA-CESTA (Raphael André) on the uncertainties propagations in the exploitation of signals from one of the plasma diagnostics used in laser experiments.

1. B. Bercu, Fr. Caron, P. Del Moral. Déconvolution de signaux par des méthodes bayesienne et algorithmes de Monte Carlo avancés. Rapports de contrats Lots 1,2 & 3 Contrat CEA CESTA-INRIA 2011-CEA-01 (2011).

Rare event simulation & uncertainty propagations in numerical codes

This technological transfer concerns an industrial contract between the INRIA team ALEA and the IFREMER in Brest (Zakoua Guédé).

1. Fr. Caron, P. Del Moral, A et E. Tantar. Simulation particulaire, Dimensionnement en conditions extrêmes (80p.) Contrat INRIA-IFREMER, 2010-IFREMER-01 (2010).

2. Application of a particle filter based subset simulation method to the reliability assessment of marine structure. Z. Guede, P. Del Moral, E. Tantar & A. Tantar. Structures, Safety and Reliability. vol. 2, ASME, Proc. of the 31th International Conference on Ocean, Offshore and Artic Engineering (2013). [link to article]

Monte Carlo methods for financial American option pricing

This technological transfer concerns an industrial contract between the INRIA team ALEA and the OSIRIS team from the EDF-Research and Development in Clamart (Nadia Oudjane).

1. P. Del Moral, P. Hu, D. Weng. Méthodes de Monte Carlo pour le pricing d'options américaines. Lot 1. Comparaisons d'algorithmes. Contrat EDF OSIRIS-INRIA (2010).

2. P. Del Moral, P. Hu Méthodes de Monte Carlo pour le pricing d'options américaines. Lot 2 et 3. Confection et analyse de nouveaux algorithmes de Monte Carlo avancés. Contrat EDF OSIRIS-INRIA (2010).

3. Snell envelope with small probability criteria. P. Del Moral, P. Hu & N. Oudjane. Applied Mathematics and Optimization. vol. 66, no. 3, pp. 309-330 (2012). [link to article]

4. Numerical Methods in Finance. R. Carmona, P. Del Moral, P. Hu & N. Oudjane. Springer Proceedings in Mathematics. Springer Berlin, Heidelberg, vol. 12, XVII (2012).

5. An introduction to particle methods in finance. R. Carmona, P. Del Moral, P. Hu & N. Oudjane. Springer Proceedings in Mathematics. Numerical Methods in Finance, Springer New York, Series: Proceeding in Mathematics (2012). [link to article]

Interacting Kalman filter for modal identification of time varying systems

This technological transfer concerns an industrial contract between the INRIA team I4S in Rennes (Miriem Zghal et Laurent Mevel) and Dassault Aviation. During a meeting at Dassault Aviation in 2011 with the team of Yves Auffray, Laurent Mevel, and François Caron, we investigated nonlinear filtering problems that arise in parameter estimation during supersonic flights. These stochastic filtering models are expressed by conditional linear and Gaussian equations. I have therefore proposed to apply a Kalman filter in the interaction. This algorithm belongs to the class of particle methods. Each particle represents the evolution of a component of the system. The probability of these simulations is measured by the corresponding Kalman predictor and the instantaneous probability of the current observation. The article related to this transfer is given below:

1. Modal parameter estimation using interacting Kalman filters. M. Zghal, L. Mevel & P. Del Moral. **Journal of Mechanical Systems and Signal Processing**. vol. 47, no. 1-2-3, pp. 139-150 (2012). [link to article]

Risk analysis of nuclear reactor vessel ruptures

This technological transfer is part of a 2011 contract between the INRIA ALEA and the Industrial Risk Management Department of EDF R. & D. in Chatou (Bertrand Iooss). We developed new particle techniques for the calculation of derivatives of risk probabilities with

respect to input parameters of a numerical code representing the mechanical behavior of reactor vessels. These techniques make it possible to quantify very finely the sources of uncertainties at the input of the mechanical code leading to accidental scenarios. We co-directed in 2010-2014 with Bertrand Iooss a PhD student Paul Lemaître (funded by a CIFRE grant) on Sensitivity analysis in reliability of structures; URL https://www.theses.fr/2014BORD0061 (50% & 50% by B. Iooss).

Underwater terrain-aided navigation using multi-sensor fusion

This technological transfer concerns an industrial contract between the INRIA team ASTRAL the ONERA Palaiseau (K. Dahia) and Naval Group (D. Laneuville). During the period 2018-2021, I have supervised the PhD of Camille Palmier (CIFRE PhD funding) on new particle filters for underwater terrain-aided navigation using multi-sensor fusion (link to PhD). The articles related to this industrial transfer are listed below:

1. Interacting Weighted Ensemble Kalman Filter applied to Underwater Terrain Aided Navigation. C. Palmier, K. Dahia, N. Merlinge, D. Laneuville & P. Del Moral. American Control Conference (ACC), 1541-1546 (2021). `[link to article]`

2. Bathymetry and Atomic Gravimetry Sensor Fusion for Autonomous Underwater Vehicle. C. Palmier, K. Dahia, N. Merlinge, D. Laneuville, P. Del Moral. IEEE 24th International Conference on Information FUSION (2021). `[link to article]`

3. Adaptive Approximate Bayesian Computational Particle Filters for Underwater Terrain-Aided Navigation. C. Palmier, K. Dahia, N. Merlinge, P. Del Moral, D. Laneuville & C. Musso. 22th International Conference on Information Fusion, FUSION 2019, Ottawa, ON, Canada, July 2-5, 2019. IEEE, FUSION (2019).

Publications list

International journals

1. On the Stability of Positive Semigroups. P. Del Moral, E. Horton & A. Jasra. **Annals of Applied Probability** (2023). [link to article]

2. Coupled Quantum Harmonic Oscillators and Feynman-Kac path integrals for Linear Diffusive Particles. P. Del Moral, & E. Horton. **Communications in Mathematical Physics** (2023). [link to article]

3. A Lyapunov approach to stability of positive semigroups: An overview with illustrations, M. Arnaudon, P. Del Moral & E.M. Ouhabaz. Stochastic Analysis and Applications (2023). [link to article]

4. On the Mathematical Theory of Ensemble (Linear-Gaussian) Kalman-Bucy Filtering, A. Bishop & P. Del Moral. **Mathematics of Control, Signals and Systems** (2023). [link to article]

5. Robust Kalman and Bayesian Set-Valued Filtering and Model Validation for Linear Stochastic Systems, A. N. Bishop & P. Del Moral. SIAM/ASA Journal on Uncertainty Quantification. Vol. 11, no. 2 (2023). [link to article]

6. A theoretical analysis of one-dimensional discrete generation ensemble Kalman particle filters. P. Del Moral & E. Horton. **Annals of Applied Probability** Vol. 33, No. 2, pp. 1127-1172 (2023). [link to article]

7. Backward Itô-Ventzell and stochastic interpolation formulae. P. Del Moral & S.S. Singh. **Stochastic Processes and their Applications**, vol. 154, pp. 197–250 (2022). [link to article]

8. A note on Riccati matrix difference equations. P. Del Moral & E. Horton (2022). **SIAM Journal on Control and Optimization**, Vol. 60, no. 3 (2022). [link to article]

9. Log-Normalization Constant Estimation using the Ensemble Kalman-Bucy Filter with Application to High-Dimensional Models. D. Crisan, P. Del Moral, A. Jasra & H. Ruzayqat. **Advances in Applied Probability** (2022). [link to article]

10. Backward Nonlinear Smoothing Diffusions. B. D. O. Anderson, A. Bishop, P. Del Moral, & C. Palmier. **Theory of Probability and its Applications, TVP SIAM**, vol. 66, no.2, pp. 245-262 (2021). [link to article]

11. Stochastic Epidemic Models inference and diagnosis with Poisson Random Measure Data Augmentation. B. Nguyen-Van-Yen, P. Del Moral & B. Cazelles. **Mathematical Biosciences**, 335, 108583 (2021). [link to article]

12. A duality formula and a particle Gibbs sampler for continuous time Feynman-Kac measures on path spaces. M. Arnaudon & P. Del Moral. **Electronic Journal of Probability**, 25, pp. 1-54 (2020). [link to article]

13. A second order analysis of McKean-Vlasov semigroups. M. Arnaudon & P. Del Moral. **Annals of Applied Probability**, vol. 30, no. 6, pp. 2613-2664 (2020). [link to article]

14. A perturbation analysis of stochastic matrix Riccati diffusions. A. N. Bishop, P. Del Moral & A. Niclas. **Annales de l'Institut Henri Poincaré Probab. & Statist.**, vol. 56, no. 2, pp. 884–916 (2020). [link to article]

15. On the Stability of Matrix-Valued Riccati Diffusions. A. N. Bishop & P. Del Moral. **Electronic J. of Probability** (2019). [link to article]

16. A variational approach to nonlinear and interacting diffusions. M. Arnaudon & P. Del Moral. Stochastic Analysis and Applications, vol. 37, no.5 (2019). [link to article]

17. An explicit Floquet-type representation of Riccati aperiodic exponential semigroups. A. N. Bishop & P. Del Moral. **International Journal of Control**. (2019). [link to article]

18. Uniform propagation of chaos and creation of chaos for a class of nonlinear diffusions. P. Del Moral & J. Tugaut. Stochastic Analysis and Applications (2019). [link to article]

19. Stability Properties of Systems of Linear Stochastic Differential Equations with Random Coefficients. A.N. Bishop & P. Del Moral. **SIAM Journal on Control and Optimization**, vol. 57, no. 2 (2019). [link to article]

20. On one-dimensional Riccati diffusions. A.N. Bishop, P. Del Moral, K. Kamatani & B. Remillard. **Annals of Applied Probability**. volume 29, Number 2, pp. 1127-1187 (2019). [link to article]

21. On the Robustness of Riccati Flows to Complete Model Misspecification. A.N. Bishop & P. Del Moral. Journal of the Franklin Institute. vol. 355, no. 15, pp. 7178-7200 (2018). [link to article]

22. On the Stability and the Exponential Concentration of Extended Kalman-Bucy filters. P. Del Moral, A. Kurtzmann & J. Tugaut. **Electronic Journal of Probability**. vol. 23, paper no. 91 (2018). [link to article]

23. Perturbations and Projections of Kalman-Bucy Semigroups Motivated by Methods in Data Assimilation. A.N. Bishop, P. Del Moral & S.D. Pathiraja **Stochastic Processes and their Applications**. vol. 128, no. 9, pp. 2857-2904 (2018). [link to article]

24. On the stability and the uniform propagation of chaos properties of Ensemble Kalman-Bucy filters. P. Del Moral & J. Tugaut. **Annals of Applied Probability**. vol. 28, no. 2, pp. 790-850 (2018). [link to article]

25. A Taylor expansion of the square root matrix functional. P. Del Moral & A. Niclas. **Journal of Mathematical Analysis and Applications**. vol. 465, no. 1, pp. 259-266 (2018). [link to article]

26. Exponential mixing properties for time inhomogeneous diffusion processes with killing. P. Del Moral & D. Villemonais. **Bernoulli**. vol. 24, no. 2, pp. 1010-1032 (2018). [link to article]

27. A Note on Random Walks with Absorbing barriers and Sequential Monte Carlo Methods. P. Del Moral & A. Jasra. Stochastic Analysis and Applications vol.36, no. 3, pp. 413-442 (2018). [link to article]

28. A sharp first order analysis of Feynman-Kac particle models, Part I: Propagation of chaos. P. Del Moral & A. Jasra. **Stochastic Processes and their Applications**. vol. 128, no. 1, pp. 332-353 (2018). [link to article]

29. A sharp first order analysis of Feynman-Kac particle models, Part II: Particle Gibbs samplers. P. Del Moral & A. Jasra. **Stochastic Processes and their Applications**. vol. 128, no. 1, pp. 354-371 (2018). [link to article]

30. On the stability of Kalman-Bucy diffusion processes. A.N. Bishop & P. Del Moral. **SIAM Journal on Control and Optimization**. vol. 55, no. 6, pp. 4015-4047 (2017). [link to article]

31. Multilevel Sequential Monte Carlo samplers for normalizing constants. P. Del Moral, A. Jasra, K. Law & Y. Zhou. ACM Transactions on Modeling and Computer Simulation. vol. 27, no. 3 (2017). [link to article]

32. Unbiased multi-index Monte Carlo. D. Crisan, P. Del Moral, J. Houssineau & A. Jasra,. Stochastic Analysis and Applications. vol. 36, pp. 257-273 (2017). [link to article]

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