Ennio Fedrizzi
Curriculum Vitae et Studiorum

Personal Information

Place and date of birth: Trento, Italy, 13/01/1985.
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Positions and Teaching

- **2016-2017: Post-doc**, Max Planck Institute, Leipzig.
- **2015-2016 : ATER** (fixed term teaching and research position), Ecole Centrale de Marseille, Institut de Mathématiques de Marseille, Marseille, France.
- **2013-2015: Post-doc,** sponsored by **Labex MILyon**, Institut Camille Jordan, Université Lyon 1.
- **03/2015 : Vacataire** (temporary lecturer), EMLYON Business School, Lyon, France. Master course "Probability for finance", 3 hours.
- **2014-2015 : Vacataire**, INSA, Lyon, France. Course in analysis, 55 hours.
- **2010-2012 : PhD in Applied Mathematics**, LPMA, Université Paris 7 Diderot, Paris, France.
- **2010-2012 : Moniteur** (PhD lecturer), Université Paris 7 Diderot, Paris, France. 64 teaching hours per year, for 2 years.
- **2010 : Vacataire**, Université Paris 6, Paris, France. Course in analysis, 24 hours.
- **2004-2009 :** Student at the **Scuola Normale Superiore** di Pisa in Sciences, Mathematics.

Graduate Studies

- **2016-2017:** **Post-doc**, Max Planck Institute, Leipzig, with Prof. Benjamin Gess: "Stochastic Burgers equation".
- **2013-2015:** **Post-doc** sponsored by Labex MILyon, Université Lyon 1 University, ICJ: "Stochastic kinetic equations", under the supervision of Professor Julien Vovelle.
- **2010-2012:** **PhD,** Paris 7 Diderot University: "Partial Differential Equations and Noise" under the supervision of Professor Josselin Garnier. Defense: December 13th, 2012. Work partially supported by the French Agence Nationale de la Recherche (project **MANUREVA - ANR**–08–SYSC–019).
- **2004-2009:** Student at the **Scuola Normale Superiore** of Pise (Italy) in Sciences, Mathematics. **Master degree (**Licenza) in Mathematics (70/70 cum LAUDE), december 21st, 2009.
- **2007-2009:** **Master degree** (Laurea Specialistica) in Mathematics **(**110/110 cum LAUDE) at Pisa University (Italy). Thesis title: "Uniqueness and flow theorems for SDEs with low regularity of the drift", under the supervision of Professor Franco Flandoli, Defense: September 25th, 2009.
- **2008**: Semester of exchange ERASMUS at ENS-Cachan, Paris (France). Local supervisor: Professor Arnaud Debussche.
- **2007**: **Bachelor Degree** (Laurea Triennale) in Mathematics **(**110/110 cum LAUDE), at Pisa University. Thesis title: "Una formula probabilistica di rappresentazione di soluzioni molto deboli di equazioni paraboliche a coefficienti poco regolari", under the supervision of Professor F. Flandoli, September 27th, 2007.
- **2004:** Awarded one of the 40 scholarships of INDAM for the Degree in Mathematics. (Renounced to accept the scholarship of the Scuola Normale Superiore of Pise).

Thesis

PhD Thesis: Partial Differential Equations and Noise, 2012. Available at http://tel.archives-ouvertes.fr/tel-00759355

Master Thesis: Uniqueness and flow theorems for SDEs with low regularity of the drift, 2009. Available at http://etd.adm.unipi.it/

Awards

-2011: **Best Master thesis** in probability award of "La Sapienza" foundation, Rome, edition 2011.

-2004: **Gold medal** at both Italian Mathematics and Physics Olympiads.

-2003: **Gold medal** at the Italian Mathematics Olympiad and honorary mention at the Italian Physics Olympiad.

Scientific Publications

- "An L^1 averaging lemma for stochastic kinetic equations", with F. Flandoli, E. Priola and J. Vovelle, in preparation.
- "Regularity of stochastic kinetic equations", with F. Flandoli, E. Priola and J. Vovelle. Accepted for publication in *Electronic Journal of Probabilit*y, preprint available on ArXiv : 1606.01088
- "On a class of stochastic transport equations for L^2_loc vector fields", with W. Neves and C. Olivera. Accepted for publication in *Annali della Scuola Normale Superiore di Pisa*. Preprint available on ArXiv : 1410.6631.
- "High frequency analysis of imaging with noise blending", *Discrete and Continuous Dynamical Systems – B*, 2014.
- "Stability of solitons under rapidly oscillating random perturbations of the initial conditions", *Annals of Applied Probability*, 2014.
- "Noise prevents singularities in linear transport equations", with F. Flandoli, *Journal of Functional Analysis*, 2013.
- "Hölder Flow and Differentiability for SDEs with Nonregular Drift", with F. Flandoli, *Stochastic Analysis and Applications,* 2013.
- "Imaging with noise blending", with M. de Hoop, J. Garnier, and K. Sølna, *Contemporary Mathematics*, 2012.
- "Pathwise Uniqueness and Continuous Dependence for SDEs with Nonregular Drift", with F. Flandoli, *Stochastics: An International Journal of Probability and Stochastic Processes*, 2011.

Conferences, seminars and short visitings

- **01/2017 Séminaire** de Probabilités, Grenoble.
- **01/2017 Séminaire** EDPs2, Chambéry.
- **10/2016** Conférence "SPDE and Related Fields", Bielefeld, Allemagne.
- **8/2016** CIME Summer school: "Singular Random Dynamics", Cetraro, Italie.
- **5/2016 Seminar** of the Analyse Appliquées research team, I2M, Marseille.
- **4/2016 Seminar:** "Regularization by noise for transport and kinetic equations", GdT Math-Cancer, Marseille, France.
- **3/2016 Invited Speaker**, Workshop "Topics on Stochastic Regularization", Toulouse (France).
- **2/2016** Winterschool: Stochastic homogenization, Augsburg (Germany).
- **7/2015** EquaDiff2015 conference, Lyon. Seminar: "Regularization by noise for transport and kinetic equations".
- **3/2015 Invited speaker**, conference *Journées Jeunes EDPistes Français*, centre Henri Lebesgue, Rennes, France.
- **3/2015 Seminar:** "Regularization by noise for transport and kinetic equations", GdT EDP-Proba, Marseille, France.

- **3/2015 Seminar:** “Régularisation par le bruit pour l’équation de transporte et l’équation cinétique”, seminar of the research team Analyse et Applications, ICJ, Lyon.
- **11/2014 Seminar :** “Regularization by Noise and Transport Equations”, Seminari di analisi matematica, Università di Torino, Italy.
- **11/2014** Conference *Journées EDP Rhône-Alpes-Auvergne*, Lyon.
- **11/2014** Conference *REvISitiNg DEcadES of conseRvation laws*, Lyon.
- **11/2014** Journée scientifique de l'Université de Lyon: *La complexité: quels défis pour demain ?* **Poster**: “Le bruit aide à résoudre des équations”.
- **10/2014** Conference *Mathematics of Fluid Dynamics*, Lyon.
- **9/2014** Rencontre thématique de l'ANR STAB : *Stability for the asymptotic behavior of PDEs, stochastic processes and their discretization*, Lyon.
- **9/2014 Invited speaker,** 4th *workshop international sur les mathématiques appliquées et la modélisation*, Université 8 Mai 1945, Guelma (Algeria). Seminars : “Some remarks on regularization by noise for PDEs” and “Noise prevents singularities in linear transport equations”.
- **9/2014** Conference “*Stochastic and PDE Methods in Mathematical Physics*”, Université Paris 7 Diderot.
- **8/2014 Invited speaker,** *International conference on stochastic analysis and related topics*, UNICAMP Campinas University (Brazil).
- **8/2014 Visiting scholar**, UNICAMP Campinas University (Brazil).
- **7/2014 Conference** *HYP2014*, IMPA, Rio de Janeiro (Brazil). Seminar: “Noise prevents singularities in linear transport equations”.
- **4/2014** Conference “*Nonlinear PDEs with random conditions*” of the trimester *EDP & Probabilités*. **Seminar**: “Stability of solitons under rapidly oscillating random perturbations of the initial conditions”. CIMI, Toulouse, (France).
- **1/2014** 9th *International meeting on stochastic partial differential equations and applications*. **Seminar**: “Noise prevents singularities in linear transport equations”. Levico (Italy).
- **12/2013 Seminar** “Régularisation par le bruit dans les équations de transport”, Journées MMCS, Lyon (France).
- **8/2013 Visiting scholar** and **invited speaker,** Workshop: *Two days in stochastic analysis*, UNICAMP Campinas University (Brazil).
- **8/2013** *Brazilian School of Probability*. **Poster** presented: “Noise prevents singularities in linear transport equations”, Mambucaba, Rio de Janeiro (Brazil).
- **4/2013** Opening conference of the semester *Perspectives in analysis and probability*, Lebesgue centre, Rennes (France).
- **7/2012** *Summer school of probability*, Saint Flour (France). Seminar: “Imaging with noise blending”.
- **6/2012** Conference of the semester *Stochastic Processes and Applications*, Bernoulli Center and EPFL, Lausanne (Suisse). **Poster** presented: “Imaging with noise blending”.
- **4/2012 Invited** as young researcher to the semester *Stochastic Processes and Applications*, Bernoulli Center and EPFL, Lausanne (Suisse). Seminar : “Stability of Solitons under Rapidly Oscillating Random Perturbations of the Initial Conditions”.
- **10/2011** 1-week **short visiting**, Università di Pisa (Italy).
- **6/2011** 35th *Stochastic Processes and Applications* conference, Oaxaca (Mexico). Seminar : “Uniqueness, Hölder flow and differentiability for SDEs with nonregular drift”.
- **5/2011 Seminar** “Uniqueness and flow theorem for SDEs with low regularity of the drift”, Groupe de travail des thésards of LPMA, Paris.
- **7/2010** *Summer school of probability*, Saint Flour (France). Seminar: Uniqueness and Flow Theorems for SDEs with low regularity of the drift.
- **11/2008** Groupe de Recherche CHANT “Approches probabilistes pour des systèmes de particules et des écoulements fluides”, Rennes 1 University and ENS-Chachan-Bretagne (France).

-5/2004 Seminar in preparation to the selection for the International Physics Olympiad at Trieste University and SISSA, Trieste (Italy).

-9/2003 Stage in preparation to the International Mathematics Olympiad at SNS, Pisa (Italy).

-8/2003 Physics summer school, organized by the Italian Physics Olympiad committee, Sassoferrato (Italy).

Languages

Italian (mother tongue), **English** (excellent written and oral level - Cambridge Advanced Certificate), **French** (good level, working language for several years), **Spanish** (good level).

Publications Presentation

- "An L^1 averaging lemma for stochastic kinetic equations", with F. Flandoli, E. Priola and J. Vovelle, in preparation.

We obtain a mixing result and an averaging lemma in L^1 for a stochastic kinetic equation with a Sobolev force term, thus lowering the (Lipschitz) regularity conditions needed in the deterministic setting.

- "Regularity of Stochastic Kinetic Equations", with F. Flandoli, E. Priola and J. Vovelle. Accepted for publication in *Electronic Journal of Probability*. Preprint available on ArXiv : 1606.01088.

We consider the linear Vlasov kinetic equation (collisionless Boltzmann equation), with a rough force term. We first obtain a well-posedness result in appropriate Besov spaces for an associated hypoelliptic degenerate PDE with a rough source term. Using the regularizing properties of this PDE, we are then able to construct a weakly differentiable stochastic flow for a degenerate SDE with Sobolev coefficients. This SDE is the equation of characteristics for the Vlasov kinetic equation with a force term having the same Sobolev regularity, perturbed by a multiplicative white noise. Thanks to the regularizing effects of the noise, the stochastic equation is well-posed and the appearance of shocks is prevented.

- "On a class of stochastic transport equations for L^2_loc vector fields", with W. Neves and C. Olivera. Accepted for publication in *Annali della Scuola Normale Superiore di Pisa*. Preprint available on ArXiv : 1410.6631.

In this work we continue the analysis of regularization by noise phenomena for transport equations. We introduce the notion of quasiregular solutions and present a new technique based on fine properties of stochastic exponentials which allows us to prove existence and uniqueness of quasiregular solutions when the drift coefficient is only locally integrable. This result seems to be a starting point to study the well-posedness of the stochastic Muskat problem.

- "High frequency analysis of imaging with noise blending", *Discrete and Continuous Dynamical Systems – B*, 2014.

In this paper I analyze the imaging algorithm with random sources considered in the paper "Imaging with noise blending" in the high frequency regime. This allows me to obtain quantitative results on the statistical stability of the algorithm and the quality (average and typical) of the image obtained.

-"Stability of solitons under rapidly oscillating random perturbations of the initial conditions", *Annals of Applied Probability*, 2014.

Here I analyze soliton solutions of the nonlinear Schrödinger and Korteweg-de-Vries equations

with random perturbations of the initial condition. I do so by means of the inverse scattering transform, which transforms these equations into coupled systems of differential equations where the initial condition enters as a potential. Using an infinite-dimensional diffusion-approximation theorem that I obtained, it is then possible to study the stability of the stochastic flow associated to these systems under very general rapidly oscillating perturbations of the initial condition. One possible application illustrated in the paper is to the study of the stability of solitons with respect to such random perturbations. Indeed, using a perturbative approach it is possible to obtain explicit formulas for the correction terms to the parameters which describe the solitons under a weak random perturbation.

- "Noise prevents singularities in linear transport equations", with F. Flandoli, *Journal of Functional Analysis*, 2013.
We obtain an existence and uniqueness result for solutions of a stochastic transport equations with only integrable drift. This result is obtained in a class of weak (in PDE sense, strong in probabilistic sense) solutions with a certain degree of Sobolev regularity. A representation formula in terms of the (stochastic) characteristics is also provided. Characteristics are here solution to the same SDE we had studied in previous works. This result shows how for linear transport equations the addition of a Stratonovich multiplicative noise term improves the qualitative theory, as in this case the appearance of shocks (classical in the deterministic setting under such weak regularity assumptions) is prevented.

- "Hölder Flow and Differentiability for SDEs with Nonregular Drift", with F. Flandoli, *Stochastic Analysis and Applications,* 2013.
Modifying the strategy used in the previous paper "Pathwise uniqueness and continuous dependence for SDEs with nonregular drift" and using the regularization effect of a different parabolic PDE, we construct a flow of Hölder continuous homeomorphisms for an SDE with only integrable drift. The flow is also differentiable in mean. The strategy is based on the use of a C^1 diffeomorphism to transform the SDE into a new equation with more regular coefficients. For this new SDE it is easier to prove the regularity results desired, which can then be brought back to the original SDE thanks to the regularity of the transformation. The regularity of this transformation is in turn linked to the regularity of solutions of a parabolic PDE.

- "Imaging with noise blending", with M. de Hoop, J. Garnier, and K. Sølna, *Contemporary Mathematics*, 2012.
We study an imaging algorithm based on the solution of an inverse problem for the wave equation. The main problem in the industrial exploitation of imaging algorithms is given by the computational costs, often prohibitively high. We show how with the use of certain carefully chosen random sources it is possible to use a simultaneous-sources approach, therefore considerably reducing computational costs, without degrading the image quality.

- "Pathwise Uniqueness and Continuous Dependence for SDEs with Nonregular Drift", with F. Flandoli, *Stochastics: An International Journal of Probability and Stochastic Processes*, 2011.
We provide a new proof (constructive rather than by contradiction) of an important result of Krylov and Röckner (2005) on existence and (pathwise) uniqueness of solutions of an SDE with integrable drift. This allows us to obtain also some regularity results of solutions. A general principle clearly appears: if it is possible to construct a good regularity theory for the heat equation with a source term having the same regularity of the drift, then we have the main tool to prove strong (pathwise) uniqueness for the SDE.