Modeling of snow avalanches and stochastic aspects
Scientific project LEA Math-Mode 2015

1 Presentation of the project

Abstract. We intend to give a new approach for the limit load problem and to compute the onset flow field, able to distinguish if an avalanche occurs or not. We also intend to investigate stochastic aspects of the snow avalanches.

The project team integrates scientists from the following three institutions:

- University Paris 13, France
- Gheorghe Mihoc-Caius Iacob Institute of Mathematical Statistics and Applied Mathematics of the Romanian Academy, Bucharest, Romania
- Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania

The members of the project team are:

- Prof. Ioan R. Ionescu from University Paris 13;
- Prof. Jean-Stéphane Dhersin from University Paris 13;
- Dr. Oana Lupaşcu, from Gheorghe Mihoc-Caius Iacob Institute of Mathematical Statistics and Applied Mathematics of the Romanian Academy;
- Prof. Lucian Beznea from Simion Stoilow Institute of Mathematics of the Romanian Academy and the University of Bucharest.

Below we present the statement of the proposed research project.

The understanding of the physics of the avalanche phenomena, related to the shallow flow of soils, snow, or other geomaterials is an important issue in geophysics and engineering; cf. for instance [An 07] and [PuHu 07]. Since

the problem is three dimensional, and the behavior of the material is best represented by visco-plastic fluid/solid type models, the mathematical and numerical modeling is very complex and poses many challenges. In order to overcome this difficulty, reduced 2-D models, called also Saint-Venant models, are generally considered; cf. [Ba 00, Mal 03, Io 13, SH 91]. Such models are able to capture the main features of the flow: onset, dynamic propagation and arrest. In [IoLu 14] and [IoLu 14a] it was studied the safety factor (of limit load) problem related to dense avalanches. It is considered the shallow flow of a visco-plastic fluid/solid with heterogeneous thickness over a plane slope and more general, over a surface with topography. It was obtained the appropriate functional space of the problem and proved the existence of an onset velocity field. It was proposed a numerical strategy based on the discontinuous velocity domain splitting (DVDS) method, introduced in [Io Ou10], to solve the limit load problem and to characterize the flow onset.

Our aim here to give a new method to solve the limit load problem and to compute the onset flow field. This criterion relates the yield limit (the material resistance) to the external forces distribution, able to distinguish if an avalanche occurs or not. The limit load problem is reduced to a minimization of a shape-dependent functional (plastic dissipation power). The collapse flow velocity field is associated to an optimum sub-domain and a rigid flow. The numerical approach we propose will take into account new techniques from nonlinear optimization theory.

The second goal of the project is to develop several stochastic methods for rupture phenomena as the avalanches. In particular, we intend to describe the snow avalanche phenomena and their time evolution, by using branching and fragmentation processes. In [Be 11] and [BeLu 14] it was given a new approach for the branching processes and the associated nonlinear PDEs (see the monographs [Dy 02] and [Li 11], and the lecture notes [LeG 99]), considering base processes with general state spaces and a wider class of kernels generating the branching, using specific stochastic analysis tools developed in [BeBo 04], [BeCoRö 11], and [BeRö 11]. Consequently, it was possible in [BeLu 14] to answer to an open question stated by T.E. Harris and to give relevant examples. The results from [BeLu 14] and [BeLuOp 12] were further used in [BeDeLu 14], in order to emphasize branching properties of the solution of a stochastic fragmentation equation and to construct a corresponding fragmentation process on the space of all fragmentation sizes introduced by J. Bertoin [Ber 06].

2 Estimated budget

We intend to use the LEA support to cover the **local costs** in Bucharest and respectively Paris for several research stages (visits) of the team members. Below we present a schedule of the visits and the estimated costs.

- Ioan R. Ionescu and Jean-Stéphane Dhersin, one week visit at Inst. of Math. in Bucharest, each: 2 x 700 = 1400 euro;

- Lucian Beznea, ten days and Oana Lupascu, two weeks, at University Paris 13: 1000 +1400 = 2 400 euro.

Total: 3 800 euro

Co-financement. We plan to cover the **travel costs** from other sources (e.g., research grands).

References

[An 07] Ch. Ancey, Plasticity and geophysical flows: A review, Journal of Non-Newtonian Fluid Mechanics 142, 4–35 (2007)

[Ba 00] N.J. Balmforth, A.S. Burbidge, R.V. Craster, J. Salzig, and A. Shen, Viscoplastic models of isothermal lava domes, J. Fluid Mech., 403, 37–65 (2000)

[Ber 06] Bertoin, J., *Random Fragmentation and Coagulation Processes*, Cambridge University Press, 2006.

[Be 11] Beznea, L., Potential theoretical methods in the construction of measure-valued branching processes, *J. European Math. Soc.* **13** (2011), 685–707.

[BeBo 04] Beznea, L. and Boboc, N.: Potential Theory and Right Processes (Mathematics and Its Applications 572), Springer Series, Kluwer, Dordrecht, 2004.

[BeCoRö 11] Beznea, L., Cornea, A., and Röckner, M., Potential theory of infinite dimensional Lévy processes, *J. Funct. Anal.* **261** (2011), 2845–2876.

[BeDeLu 14] Beznea, L., Deaconu, M., and Lupaşcu, O., Branching processes and stochastic fragmentation equation, *Stochastic Processes and their Applications*, 2014, doi:10.1016/j.spa.2014.11.016

[BeLu 14] Beznea, L. and Lupaşcu, O., Measure-valued discrete branching Markov processes, *Trans. Amer. Math. Soc.* 2014 (to appear).

[BeLuOp 12] Beznea, L., Lupaşcu, O., and Oprina, A.-G., A unifying construction for measure-valued continuous and discrete branching processes. In: *Complex Analysis and Potential Theory,* CRM Proceedings and Lecture Notes, vol. **55**, Amer. Math. Soc., Providence, RI, 2012, pp. 47–59.

[BeRö 11] Beznea, L. and Röckner, M., From resolvents to càdlàg processes through compact excessive functions and applications to singular SDE on Hilbert spaces, *Bull. Sci. Math.* **135** (2011), 844–870.

[Dy 02] Dynkin, E. B., *Diffusions, Superdiffusions and Partial Differential Equations,* Amer. Math. Soc. Colloq. Publ. **50**, Amer. Math. Soc., 2002.

[Io 13] I.R. Ionescu, Viscoplastic shallow flow equations with topography, Journal of Non-Newtonian Fluid Mechanics, 193, 11–128 (2013)

[IoLu 14a] I.R. Ionescu and O. Lupascu, Onset of a dense avalanche on a plane slope, 2014 (submitted)

[IoLu 14] I. R. Ionescu and O. Lupascu, Modeling shallow avalanche onset over complex basal topography, Advances in Computational Math., 2014, to appear

[Io Ou10] I.R. Ionescu and E. Oudet, Discontinuous velocity domain splitting method in limit load analysis *Int. J. Solids and Structures,* **47**, (2010), 1459–1468

[LeG 99] Le Gall, J.-F., *Spatial Branching Processes, Random Snakes and Partial Differential Equations* (Lectures in Math. ETH Zürich) Birkhäuser, 1999.

[Li 11] Li, Z. H., *Measure-Valued Branching Markov Processes,* Probab. Appl., Springer, 2011.

[Mal 03] A. Mageney-Castelneau, J.P. Villote, M.O. Bristeau, B. Perthame, F. Bochut, C. Simeoni, and S. Yernei, Numerical modeling of avalanches based on Saint-Venant equations using a kinetic scheme, J. Geophys. Res., 108 B11, 2527 (2003)

[SH 91] S.B. Savage and K. Hutter, The dynamics of granular materials from initiation to runout, Acta Mechanica, 86, 201–223 (1991)

[PuHu 07] S. P. Pudasaini and K. Hutter, Avalanche Dynamics - Dynamics of Rapid Flows of Dense Granular Avalanches, Springer (2007)

Curriculum Vitae

Oana-Valeria Lupaşcu

Permanent address: *Gheorghe Mihoc-Caius Iacob Institute of Mathematical Statistics and Applied Mathematics of the Romanian Academy, Bucharest*
Current address (until April 2015): *INRIA, Villers-ls-Nancy, F-54600, France; Université de Lorraine, CNRS, Institut Elie Cartan de Lorraine - UMR 7502, Vandoeuvre-lès-Nancy, F-54506, France*
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Personal

Born : December 14th, 1986, Scorniceşti, Romania

Citizenship : Romanian

Education

PhD in Mathematics (September 2010 - November 2013) *Probabilistic and deterministic models for fracture type phenomena,* in the frame of a cotutelle agreement between Paris 13 University, France, and Simion Stoilow Institute of Mathematics of the Romanian Academy (IMAR) in Bucharest, Romania; under the joint supervision of Prof. Dr. Ioan R. Ionescu (University Paris 13) and Prof. Dr. Lucian Beznea (Simion Stoilow Institute of Mathematics of the Romanian Academy).

Master in Mathematics at Şcoala Normală Superioară Bucureşti (Ecole Normale Supérieure de Bucarest), following an high contest examination, September, 2011
http : *//www.imar.ro/*˜ *purice/SNS/homepage/index_eng.php*3

Master in Applied Mathematics at the Faculty of Mathematics and Informatics, University of Pitesti, Romania, 2010

BS in Mathematics at University of Piteşti, Romania, 2008

Professional positions

- Junior research position "Gheorghe Mihoc-Caius Iacob" Institute of Mathematical Statistics and Applied Mathematics of the Romanian Academy, Bucharest, Romania

- Assistent Professor at POLITEHNICA University of Bucharest, Department of Mathematics (October 2011 - September 2014).

Teaching activities

- Seminars on real analysis (license L1), University of Lorraine, Nancy, France, 2014.

- Seminars on probability (license L1), University of Lorraine, Nancy, France, 2014.

- Seminars on rigid solid mechanics (license L2), University Paris 13, France, 2013.

- Seminars on linear algebra and geometry (license L1), real analysis (license L1), probability and statistics (license L2), POLITEHNICA University Bucharest, 2010-2012.

Publications

- L. Beznea and **O. Lupaşcu**, Measure-valued discrete branching Markov processes. *Trans. Amer. Math. Soc.*, 2014, to appear.

- I. R. Ionescu and **O. Lupaşcu**, Modeling shallow avalanche onset over complex basal topography, *Advances in Computational Math.* 2015, DOI: 10.1007/s10444-015-9407-2

- **O. Lupaşcu**, Subordination in the sense of Bochner of L^p-semigroups and associated Markov processes. *Acta Mathematica Sinica, English Series* **30** (2014), 187-196.

- L. Beznea, **O. Lupaşcu**, and A.-G. Oprina, A unifying construction for measure-valued continuous and discrete branching processes. In: *Complex Analysis and Potential Theory*, CRM Proceedings and Lecture Notes, vol. **55**, Amer. Math. Soc., Providence, RI, 2012, pp. 47-59.

- L. Beznea, M. Deaconu, and **O. Lupaşcu**, Branching processes for a fragmentation equation, *Stochastic Processes and their Applications*, 2015, DOI:10.1016/j.spa.2014.11.016

Prepublications/Preprints

- I. R. Ionescu and **O. Lupaşcu**, *Onset of a dense avalanche on a plane slope,* preprint, 2014 (submitted)

Talks at Conferences

- *Journées Modélisation Aléatoire Statistique*, Toulouse, France, August 2014

- *Colloque Franco-Roumain de Mathematiques Appliquees*, Lyon, France, August 2014

- *Journées de Probabilités*, Marseille, France, May 2014

- *TOSCA Seminar*, La Petite Pierre, France, November 2013

- *Joint International Meeting of the AMS and the Romanian Mathematical Society*, Alba Iulia, Romania, June 2013, http://imar.ro/ams-ro2013/talks.html

- *PDEs and Stochastic Processes, The 5th Workshop Series on Mathematics*, Piteşti, Romania, October 2012, http://imar.ro/PDE&StoPr-Pitesti12/talks.php

- *International Conference on Controlled Deterministic and Stochastic Systems*, Iassy, Romania, July 2012, http://www.math.uaic.ro/ ITN2012/files/talk/Lupascu.pdf

- *International Conference on Complex Analysis and Related Topics, The 13th Romanian-Finnish Seminar*, Ploieşti, Romania, June 2012, http://imar.ro/RoFinSem2012/ListaTalk-RoFinSem12.pdf

- *Probability and Related Aspects*, Alba Iulia, Romania, May 2012, http://www.imar.ro/ProbAlbaIulia2012/ListaTalk-AlbaIulia12.pdf

- *Spring School in Probability*, Dubrovnik, Croatia, April 2012, http://web.math.pmf.unizg.hr/ssp-iuc/poster/Booklet

Talks in Scientific Seminars

- *Analysis and Stochastics Seminars* of Technical University Dresden, Germany, invited by Prof. Dr. René Schilling, June 2012 http://www.math.tu-dresden.de/sto/schilling/ag/past-programmes.html#summer12

- *Potential Theory Seminar*, organized by IMAR and University of Bucharest, Faculty of Mathematics and Computer Science, September 2013.

Grants

- Member of the research team of the national research project entitled *Mathematical Modeling of Ductile Rupture*, founded by the Romanian Ministry of Education and Research, 2011-2014.

Scientific collaborations (visits abroad)

- Two scientific visits of one week in 2012 at Institut Elie Cartan de Lorraine, France, invited by Prof. Dr. Madalina Deaconu

- A scientific visit of one week at Technical Univ. Dresden, Germany, invited by Prof. Dr. René Schilling, June 2012

Participation at conferences, workshops, and summer schools

- *Evolution equation and numerical analysis*, SIMUMAT Summer School from Castro Urdiales, Cantabria, Spain, July 2009

- *Partial Differential Equation*, Summer School from Cortona, Italy, August 2010

- *The first NIMS Probability Summer School*, Daejeon, South Korea, August 2011

- *Partial differential equations, optimal design and numeric*, Benasque, Spain, August 2011

- *XI– ème Colloque Franco–Roumain de Mathèmatiques Appliquées*, Bucharest, August 2012

- *Brussels Summer School of Mathematics*, Brussels, August 2013

Member of the local organizing committee of the following international conferences:

- *The Eighth Congress of Romanian Mathematicians*, Iaşi, Romania, June 2015

- *Joint International Meeting of the AMS and the Romanian Mathematical Society*, Alba Iulia, Romania, June 2013

- *International Conference on Complex Analysis and Related Topics, The 13th Romanian-Finnish Seminar*, Ploieşti, Romania, June 2012

- *Probability and Related Aspects*, Alba Iulia, Romania, May 2012

- *The Seventh Congress of Romanian Mathematicians*, Braşov, Romania, June 2011 http://imar.ro/organization/activities/standalone/congmatro2011/conf.php

Fellowships

- Postdoctoral fellowship of the INRIA, France: 16 months, since December 2013.

- PhD fellowship of the Cultural Service of the French Embassy in Bucharest: support for 12 months, during two academic years (2011-2013).

- PhD fellowship in a POSDRU project, co-founded by EU and the Romanian Government, 2011-2013.

- BITDEFENDER Junior Research fellowship at IMAR: 6 months in 2010.

PC Skills: Matlab, LaTeX

Foreign Languages: French, English

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1 Curriculum Vitae

Études, Diplômes

01.1990-Doctorat d'État en Mathématiques et Mécanique, Université de Bucarest
07.1982-DEA de Mathématiques et Mécanique, Université de Bucarest

Fonctions scientifiques

09.2007 - Professeur (Classe Exceptionnelle au 09.2012), LSPM, Université Paris 13
09.1994 - Professeur (1ère classe au 09.2005), LAMA, Université de Savoie
12.1993 - Directeur de Recherche, Institut de Mathématiques de l'Académie Roumaine
09.1988 - Chargé de Recherche, Institut de Mathématiques de l'Académie Roumaine
09.1983 - Attaché de Recherche, Institut de Mathématiques de l'Académie Roumaine

Direction, animation laboratoires et équipes de recherche

2011- présent, Responsable de l'équipe MER de LSPM
2001-2007 et 1995-1999 : Responsable de l'équipe EDP de LAMA
1997-2001 : Directeur du LAMA, (UMR 5127 - CNRS et Université de Savoie)

Direction et animation de formations

2005 -2007: Responsable du Master 2 Recherche
2001: Directeur de l'Ecole Doctorale de d'Université de Savoie (EDUS)
1994-1997 : Responsable du DESS Ingénierie Mathématique

PES/PEDR : 09.1998-09.2014

CRCT : 6 mois en 2006/2007

Distinction Scientifique : 1988 - Prix "Gheorghe Titeica" de l'Académie Roumaine

Direction de thèses : 10 thèses de 3ème cycle (9 soutenues, 1 en cours)

Publications

72 articles parus dans des revues avec comité de lecture
21 articles parus dans des livres et proceedings avec comité de lecture
1 ouvrage publié à Oxford University Press, 2 livres édités à Wiley (2010, 2011),
544 citations, h-index: 14, http://www.researcherid.com/rid/B-9422-2011

Organisation manifestations scientifiques

-*4th US-France ICACM workshop*: Scale transition for plastic crystalline and microstructured materials: from experiment to numerical modeling, IHP Paris, 2-4 June 2010
-*8ième Colloque Franco-Roumain de mathématiques Appliquées*, Chambéry, 28 août - 1er septembre 2006
-*Modélisation numérique en géomécanique. Applications au stockage des déchets radioactifs*, Chambéry, 29-30 novembre 2004.
-*Calcul des Variations*, Le Bourget-du-Lac, 10-13 Juin 2003
-*Doctoriales 2002,* 24-29 Mars 2002, Sévrier Lac d'Annecy
-*Modélisation des séismes et changement d'échelles,* Chambéry, 17-18 mai 2001
-*Instabilités du Frottement,* Bourget-du-Lac, 27-29 septembre 1999

Responsabilités des projets de recherche

2014-2016 - *PEGES*, projet IDEX-SPC, co-responsable
2012-2014 - *S4*, ANR blanc, responsable partenaire LSPM
2010-2011 - *Multi-scale problems for dynamic earthquake rupture*, SAKURA (France-Japon)
2007-2010 - *PLANETEROS*, ANR blanc, responsable partenaire LAMA
2005-2008 - *Pénétration à haute vitesse dans des matériaux géologiques*, DGA
2004-2007 - *Modélisation Mathématiques de la Vulnérabilité des Ouvrages*, Rhône-Alpes
2003-2004 - *Penetration into a compressible viscoplastic material*, US Air Force
2001-2005 - *Modélisation des séismes et changement d'échelles*, ACI (partenaire LAMA)
1998-2001 - *Modélisation des Instabilités en Géophysique*, Univ. de Savoie

Visites récentes dans des universités étrangères

Longue durée : 04.2011 Institute of Mathematics of Romanian Academy, 1 mois; 08.2010 - University of Florida (EU), REEF,1 mois; 08.2009 - University of Florida (EU), REEF,1 mois; 08.2008 - University of Florida (EU), REEF; 01-03.2007 - University of Kobe (Japon), RCUSS, 3 mois; 08.2006 - University of Florida (EU), REEF, 1 mois; 08.2005 - University of Florida (EU), GERC, 1 mois; 08.2004 - University of Florida (EU), GERC, 1 mois; 01.2003 Institute of Mathematics of Romanian Academy, 1 mois.
Courte durée : 06.2014- Renslaer Polytechnic Institute, EU; 10.1012- Behuan University, Beijing, Chine; 10.2011 - University of Kobe (Japan), RCUSS; 09.2010 - University of Tokyo (Japan), ERI; 03.2010 - University of Kobe (Japan), RCUSS, 05.2009-Institute of mathematics of Romanian Academy (Roumanie), 10.2008- Worcester Polytechnic Institute (EU), 02.2007-University of Tokyo (Japon), 06.2007-Université de Bucarest (Roumanie), 11.2007-Duke University (EU), 09.2006-Université de Parme (Italie), 02.2006-Université de Bucarest (Roumanie), 05.2004 - Université de Satander (Espagne), 05.2004-Institute of mathematics of Romanian Academy (Roumanie), 03.2003-Worcester Polytechnic Institute (EU)

2 Publications- Ioan[1] R. Ionescu

References

2.1 Ouvrages

[1] I. R. Ionescu, S. Bouvier, O. Cazacu and P. Franciosi (editors), *Plasticity of crystalline materials: from dislocations to continuum*, Wiley, 336 pages, 2011

[2] E. Buzaud, I. R. Ionescu and G. Z. Voyiadjis (editors), *Materials under Extreme Loadings: Application to Penetration and Impact*, Wiley, 416 pages, 2010

[3] I. R. Ionescu and M. Sofonea, *Functional and numerical methods in viscoplasticity*, (Oxford Mathematical Monographs); Oxford University Press, 265 pages, 1993

2.2 Articles parus dans des revues internationales à comité de lecture

[4] I. R. Ionescu and O. Lupascu, Modeling shallow avalanche onset over complex basal topography, accepted at *Advances in Computational Mathematics* (2014)

[5] I. R. Ionescu, Augmented Lagrangian for shallow viscoplastic flow with topography, *Journal of Computational Physics* Vol. 242 (2013), 544–560

[6] I. R. Ionescu, Viscoplastic shallow flow equations with topography, *J. Non-Newtonian Fluid Mechanics* Vol. 193 (2013), 116–128

[7] G. Carlier, M. Comte, I. R. Ionescu and G. Peyré A Projection approach to numerical analysis of limit load problems, *Mathematical Models and Methods in Applied Sciences*, Vol. 21, Issue: 6(2011), 1291–1316, DOI: 10.1142/S0218202511005325

[8] S. Latour, M. Campillo, C. Voisin, I. R. Ionescu, J. Schmedes, and D. Lavallée, Effective friction law for small?scale fault heterogeneity in 3D dynamic rupture, *J. Geophysical Research*, Vol. 116, 18 pages, B10306, doi:10.1029/2010JB008118, 2011

[9] I. R. Ionescu, Onset and dynamic shallow flow of a viscoplastic fluid on a plane slope, *J. Non-Newtonian Fluid Mechanics* Vol. 165, 19-20 (2010), 1328–1341

[10] O. Cazacu, I. R. Ionescu, Dynamic crystal plasticity: an Eulerian approach, *Journal of Mechanics and Physics of Solids* doi:10.1016/j.jmps.2010.04.001, vol 58, Issue 6 (2010), 844–859

[11] I.R. Ionescu and E. Oudet, Discontinuous velocity domain splitting in limit analysis, *Int. J. Solids and Structures*, doi:10.1016/j.ijsolstr.2010.02.012, vol. 47 (2010), 1459–1468

[12] O. Cazacu, I. R. Ionescu and J.-W. Yoon, Orthotropic strain rate potential for the description of anisotropy in tension and compression of metals, *International Journal of Plasticity*, doi:10.1016/j.ijplas.2009.11.005, Vol. 26, Issue 2 (2010), 887–904

[1] L'ordre des auteurs est en général alphabétique, comme c'est l'usage en mathématique, à l'exception des revues de géophysique où d'autres critères ont été pris en compte.

[13] S. Hok, M. Campillo, F. Cotton, P. Favre and I.R. Ionescu, Off-fault Plasticity Favors the Spontaneous Arrest of Dynamic Ruptures on Strength Heterogeneity: the 2D In-plane and Anti-plane Cases, *Geophysical Research Letters*, (2010) 37, L02306, doi:10.1029/2009GL041888

[14] O. Cazacu and I. R. Ionescu, Augmented Lagrangian method for Eulerian modeling of viscoplastic crystals, *Computer Methods in Appl. Mech. and Engng.*, vol. 199 (2010), 68–699

[15] M. Ghergu and I.R. Ionescu, Structure-soil-structure coupling in seismic excitation and "city effect", *Int. Journal of Engng. Sciences*, 47 (2009) 342–354

[16] I. R. Ionescu and D. Volkov, Detecting tangential dislocations on planar faults from traction free surface observations, *Inverse Problems*, 25, 1, (2009), doi:10.1088/0266-5611/25/1/015012, 25 pages

[17] L. Badea, I. R. Ionescu and S. Wolf, Schwarz method for earthquake source dynamics, *Journal of Computational Physics*, 227 (2008), 3824–3848

[18] O. Cazacu, I. R. Ionescu and T. Perrot, Numerical modeling of projectile penetration into compressible rigid viscoplastic media, *Int. J. Numer. Meth. Engng.*, 74, 8 (2008), 1240–1261

[19] I. R. Ionescu and D. Volkov, Earth surface effects on active faults: An eigenvalue asymptotic analysis, *J. of Comp. Appl. Math.* , 220, 1-2, (2008), 143–162

[20] R. Hassani, I. R. Ionescu and N. Sakki, Unstable perturbation of the equilibrium under Coulomb friction. Nonlinear eigenvalue analysis, *Computer Methods in Appl. Mech. and Engng.*,vol. 196 (2007), 2377–2389

[21] R. Hassani, I. R. Ionescu and E. Oudet, Critical friction for wedged configurations, *Int. J. of Solids and Structures*, vol. 44 (2007), 6187-6200

[22] D. Bucur and I.R. Ionescu, Asymptotic analysis and scaling of friction parameters, *Journal of Applied Mathematics and Physics (ZAMP)*, 57, 1042–1056, 2006

[23] O. Cazacu, I. R. Ionescu and T. Perrot, Steady-state flow of compressible rigid-viscoplastic media, *Int. Journal of Engng. Sciences*, vol 44 (2006), 1082–1097

[24] O. Cazacu and I. R. Ionescu, Compressible rigid viscoplastic fluids, *Journal of Mechanics and Physics of Solids*, Vol. 54 (2006) Issue 8, 16640–1667

[25] I. R. Ionescu and D. Volkov, An inverse problem for the recovery of active faults from surface observations, *Inverse Problems*, 22, No 6 (2006), 2103–2121

[26] S. Wolf, I. Manighetti, M. Campillo and I. R. Ionescu, Mechanics of normal fault networks subject to slip weakening friction, *Geophysical Journal, International*, 165 (2006), 677–691

[27] R. Hassani, L. R. Ionescu and T. Lachand-Robert, Shape Optimization and Supremal Minimization Approaches in Landslides Modeling, *Applied Mathematics and Optimization*, vol 52, (2005) 349–364,

[28] I. R. Ionescu and T. Lachand-Robert, Generalized Cheeger sets related to landslides, *Calculus of Variations and PDE*, vol. 23, (2005) 227–249

[29] I. R. Ionescu, D. Onofrei and B. Vernescu, Γ-convergence for a fault model with slip-weakening friction and periodic barriers, *Quarterly of Applied Mathematics*, vol. LXIII, 4, 747–778

[30] I. R. Ionescu and S. Wolf, Interaction of faults under slip-dependent friction. Non-linear eigenvalue analysis, *Mathematical Methods in the Applied Sciences (M2AS)*, Vol. 28, 77–100, 2005

[31] L. Badea, I. R. Ionescu and S. Wolf, Domain decomposition method for dynamic faulting under slip-dependent friction, *Journal of Computational Physics*, 201, (2004) 487-510

[32] M. Campillo, C. Dascalu and I. R. Ionescu, Instability of a Periodic System of Faults, *Geophysical Journal, International*, vol.159, 212-222, 2004

[33] C. Dascalu and I. R. Ionescu, Slip weakening friction instabilities : eigenvalue analysis, *Mathematical Models and Methods in Applied Sciences (M3AS*), Vol. 14, No. 3, 2004

[34] R. Hassani, P. Hild and I. R. Ionescu, Sufficient conditions of non-uniqueness for the Coulomb friction problem , *Mathematical Methods in the Applied Sciences (M2AS)*, Vol. 27, No. 3, 47–67, 2004

[35] I. R. Ionescu and V. Radulescu, Nonlinear eigenvalue problems arising in earthquake initiation, *Adv. Diff. Equations*, Vol. 8, No. 7, 769–786, 2003

[36] R. Hassani, P. Hild, I. R. Ionescu and N. Sakki, A mixed finite element method and solution multiplicity for Coulomb frictional contact, *Computer Methods in Appl. Mech. and Engrg.*, vol. 192, 4517–4531, 2003

[37] I. R. Ionescu, Q.L. Nguyen and S. Wolf, Slip-dependent friction in dynamic elasticity, *Nonlinear Analysis*, Vol. 53, No.3-4, 375–390, 2003

[38] H. Perfettini, M. Campillo and I. R. Ionescu, On the scaling of the slip weakening rate of heterogeneous faults, *Journal of Geophysical Research*, Vol. 108, No. B9, 2410, 2003

[39] I. R. Ionescu, Viscosity solutions for dynamic problems with slip rate dependent friction, *Quarterly of Applied Mathematics*, vol 60, No. 3, 461–476, 2002

[40] P. Hild, I. R. Ionescu, T. Lachand-Robert and I. Rosca, The blocking of an inhomogeneous Bingham fluid. Applications to landslides, *Mathematical Modelling and Numerical Analysis (M2AN)*, Vol. 36, No. 6, 1013–1026, 2002

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2.3.1 Articles dans des proceedings à comité de lecture

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2.4 Articles de popularisation scientifique

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2.4.1 Conférences internationales à comité de lecture après 2003

[98] I. R. Ionescu and O. Cazacu, Dynamic visco-plastic crystals: an eulerian modeling," International Plasticity Symposium" , Nassau, January 2013 (key-note speaker)

[99] I. R. Ionescu, From Cheeger problem to limit analysis, "American Joint Mathematics Meetings", San Diego, (USA), January 2013

[100] I. R. Ionescu, Shallow viscoplastic flow over a natural topography, "International Conference on Approximation Methods and Numerical Modelling in Environment and Natural Resources (MAMERN)", Granada (Spain), April 2013

[101] I. R. Ionescu, Viscoplastic shallow flow equations with topography, "6e Biennale Française des Mathématiques Appliquées et Industrielles", Seignosse-Le-Penon (France), May 2013

[102] I. R. Ionescu, Augmented Lagrangian for shallow viscoplastic flow with topography, "Joint International Meeting of the American Mathematical Society and the Romanian Mathematical Society", Alba-Iulia, June 2013

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[112] I.R Ionescu, D. Volkov, Could we detect earthquake nucleation from surface observations ?, 2010 September, 1st QUEST (Quantitative estimation of Earth's seismic source and structure) workshop, Alghero, Italy

[113] Ioan R. Ionescu and Oana Cazacu, Projectile penetration into compressible visco-plastic media, 2nd International Workshops on Advances in Computational Mechanics, March 29-31, 2010, Yokohama, Japan

[114] I.R Ionescu, O Cazacu, Numerical modeling of rate-dependent crystal plasticity, 2010 janvier, St. Kitts, Int. Plasticity Symposium janvier, 2010, EU

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[122] I. R. Ionescu, S. Wolf, L. Badea, Schwarz Method for Slip Weakening Friction with Applications to Earthquake Source Dynamics, Juin 2008, Venice, IACM-ECCOMAS, 2008 World Congress Computational Mechanics, Italy

[123] I.R Ionescu, E. Oudet, Modeling ductile fracture using the discontinuous velocity domain splitting method, 2008 mars, New Orleans, TMS 13th Annual Meeting and Exhibition, EU

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[131] I.R Ionescu, R. Hassani, Equilibrium configurations with Coulomb friction. Existence, multiplicity and stability, 2006 June, Lisbon, *ECCM-2006, III European Conference on computational mechanics*, Portugal

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[135] I.R Ionescu, O. Cazacu, Penetration of a rigid body into a compressible rigid-viscoplastic fluid, 2005 December, Chillan, *ANCIF'05, Numerical Analysis and control of fluid-structure interactions*, Chili

[136] I.R Ionescu, Rigid-visco-plastic fluids : a solid mechanics perspective, 2005 October, Banff International Research Station, *Viscoplastic Fluids: From Theory to Applications*, Canada

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[144] I. R. Ionescu, S. Wolf, L. Badea, Schwarz decomposition method in capturing friction instabilities, 2004 July, Jyvaskyla, *European Congress on Computational Methods in Applied Sciences and Engineering*, Finlande

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[147] S. Wolf, P. Favreau, I. R. Ionescu, Initiation and rupture propagation computed with high spatial order finite differences, 2003 March, Austin, *SIAM conference on the numerical methods in geophysics*, USA

CURRICULUM VITAE

Name: **Lucian BEZNEA**

Citizenship: Romanian

Current profesional position:

• Director of the Simion Stoilow Institute of Mathematics of the Romanian Academy, Bucharest, Romania, since April 2012

• Professor at the University of Bucharest, Faculty of Mathematics and Computer Science, since October 2012.

Education: Faculty of Mathematics, University of Bucharest (diploma thesis) and completed with the master thesis in analysis

Ph. D.: Doctor in Mathematics at the University of Bucharest, 1990
Ph. D. supervisor: Prof. Dr. Nicu Boboc.

European languages: English, French, German.

Profesional occupation:

• 1983–1990: junior researcher position at the Department of Mathematics of the National Institute for Scientific and Technical Creation in Bucharest

• Since 1990: senior research position at the Simion Stoilow Institute of Mathematics of the Romanian Academy, senior researcher first degree since 1999; according to the Romanian law (OGU No. 33/22.09.2001) this position is equivalent with a full professor position

• Deputy Director of the Simion Stoilow Institute of Mathematics of the Romanian Academy, October 2004-March 2012

Research domain: Stochastic analysis and potential theory, applications in PDE and infinite dimensional analysis.

Member of:

• the Commission Support of East European Mathematicians of the European Mathematical Society

• the committee of experts of the Laboratoire Européen Associé CNRS Franco-Roumain (Math Mode)

• the directorial committee of the Romanian Mathematical Society

• the scientific committee of 9ème Coll. Franco-Roumain de Math. Appl., 2012, Bucharest, two Fields medalists as invited speakers

• the editorial boards of the following journals: Proc. of the Romanian Academy, Math. Reports; Revue Roumaine Math. Pures Appl., Ann. Univ. Bucharest, Advances in Pure and Applied Mathematics (De Gruyter)

• the directorial councils of the following doctoral schools in mathematics: Univ. of Potenza, Italy, Romanian Academy, University of Bucharest, Al. I Cuza Univ. Iaşi, Ovidius Univ. Constanţa, Romania

Award: 2004 Simion Stoilow Award of the Romanian Academy

Teaching activities:

• 1998-2009: Faculty of Mathematics of the University of Bucharest and University of Piteşti: courses on potential theory and stochastics, probability theory and PDE for master in applied analysis, functional analysis, complex analysis,

• 2009-2012: Şcoala Normală Superioară Bucharest (École Normale Supérieure de Bucarest); courses on Dirichlet forms, measure-valued branching processes, and stochastic processes

• 2011- : Faculty of Mathematics and Computer Science of the University of Bucharest; courses on probability theory and stochastic processes

Ph.D. supervisor: approved by the Romanian Ministry of Education and Research; four supervised theses, supervising currently three Ph.D. students

Visits abroad longer than one month (selection):

• One month visit at Univ. Eichstätt, Germany, January 2006

• Visits at Bonn University, Institut für Angewandte Mathematik, with grants from DAAD, in 1998 (two months) and 2003 (two months)

• One month research visit at the University of Toulouse (Laboratoire de Probabilités et Statistique), France, 2007

• Research visits at the University of Bielefeld, Germany: one month in 2003; three months in 2004, three months in 2005, two months in 2006, two months in 2007, six weeks in 2008, and five weeks in 2009, in the frame of a cooperation project in potential theory and stochastics; two months in January-February 2010 (mini-course at the doctoral school "International Graduate College"), October 2010; tho months in 2013; six weeks in 2014

• One month research visit (invited professor) at University of Paris-Sud (Équipe Probabilités et Statistiques), Orsay, November 2011

• Univ. de Lorraine, Nancy, France, 2014 (one month), invited by M. Deaconu

Other visits abroad:

• Univ. Paris VI, Equipe d'Analyse, France, December 2003 (two weeks), invited by G. Mokobodzki and A. de La Pradelle

• Research Institute for Mathematical Sciences (RIMS), Kyoto, Japan, September 2006 (three weeks), invited by T. Kumagai

• Institute of Applied Mathematics, Chinese Academy of Sciences, Beijing, April 2008 (two weeks), invited by Z.-M. Ma

• Worcester Polytechnic Institute, USA, April 2010 (three weeks), invited by U. Mosco and B. Vernescu

• Univ. Paul Sabatier Toulouse, December 2010 (two weeks), invited by D. Bakry

• INRIA Nancy, France, April, November, December 2012 (six weeks), May-June 2013 (two weeks), invited by M. Deaconu

• Univ. Paris-Nord, France, July 2013 (three weeks), invited by I. R. Ionescu.

Conferences (selection): I participated and gave talks at over 50 international mathematical meetings. In the last five years I was invited speaker at the following conferences:

• Colloque de la Société Mathématique de Tunisie , March 2010

• Korean Math. Soc. Spring Meeting, Seoul, South Korea, April 2011

• "Stochastics and Real World Models 2011", Bielefeld, Germany, July 2011

• New Trends in Modern Analysis Probabilistic and Analytic Methods in PDEs and Spectral Theory, Hammamet, Tunisia, November 2011

• "International Conference on Controlled Deterministic and Stochastic Systems", Iaşi, Romania, July 2012

• "Bielefeld Stochastic Summer", Bielefeld, Germany, August 2013

• International Conference on Applied and Pure Mathematics, Iaşi, Romania, November 2013

• 7th International Conference on Stochastic Analysis and its Applications, Seoul, August 2014

• Dirichlet Form Theory and its Applications, Oberwolfach, Germany, October 2014

• "Bielefeld Stochastic Autumn (CRC)", Bielefeld, Germany, December 2014

Lectures given at universities or research institutes (selection, in the last five years):

• University of California at San Diego, USA, September 2009 and September 2011

• Purdue University, West Lafayette, USA, September 2009 and September 2011

• Worcester Polytechnic Institute, Worcester, USA, September 2009 and September 2011

• Invited Professor at IPEIT (University of Tunis), Tunisia, February 2009 and 2010, April 2014

• Wroclaw University of Technology, Poland, July 2010

• IGK Seminar/AG Stochastic Analysis, Bielefeld University, Germany, August 2010

• Seoul National University, South Korea, April 2011

• University of Oxford, Great Britain, October 2011

• Imperial College, London, Great Britain, October 2011

• University of Paris-Sud, Orsay, France, November 2011

• INRIA Nancy, France, April 2012

• Basque Center for Applied Mathematics (BCAM), Bilbao, Spain, July 2012

• "O. Mayer" Institute of Mathematics, Iaşi, Romania, March 2013

• University of Paris-Nord, France, November 2013.

• University of Göteborg, Sweden, May 2014.

Managerial experience in international collaborations:

• Co-director (jointly with Michael Röckner), of a research collaboration project between the Institute of Mathematics "S. Stoilow" of the Romanian Academy and the University of Bielefeld (Germany), in potential theory and stochastics (2004-2007), supported by DFG and the Romanian Academy

• Co-organizer (jointly with Michael Röckner) of the workshop "Potential Theoretical Methods for Infinite Dimensional Processes", Bielefeld (Germany), August 9-11, 2004 (participants from 7 countries)
• Chief of the Potential Theory Task of the EURROMMAT project financed by the European Commission (under FP5), contract No. ICA1-CT-2000-70022 (the Call for Centers of Excellence from 1999)

• Co-organizer of over 25 international conferences, including the following (a selection, in the last five years):

• *Workshop on Asymptotic Analysis and Stochastic Methods for Heterogeneous Media,* Alba Iulia, Romania, June 2010

• *Exploratory Workshop–Teme actuale de cercetare in matematici aplicate*, Bucharest, September 2010

• Secretary of the Organizing Committee of *The Seventh Congress of Romanian Mathematicians*, Brasov, Romania, June 2011; over 350 participants from 25 countries

• *Probability and Related Aspects*, Alba-Iulia, May 2012; 30 participants from 7 countries

• *The 13th Romanian-Finnish Seminar*, June 2012, Ploieşti, Romania; over 90 participants from 15 countries

• *PDEs and Stochastic Processes–The 5th Workshop Series on Mathematics*, Piteşti, Romania, October 2012

• Member of the Program Committee of the *Joint International Meeting of the American Math. Soc. and Romanian Math. Soc.*, June 2013, Alba Iulia, Romania

• *Faculty of Sciences–150 Years*, August 29 – September 1, 2013, Bucharest, Romania

National Grants: Coordinator of several national grants: 1999, 2000, 2001-2002, 2003-2005, 2006-2008, 2009-2011 • Coordinator of three national research contracts of the Inst. of Math. of the Romanian Academy, financed by the Romanian Ministry of Education and Research: one in the period 2001-2003, and two in the period 2005-2008

List of Publications - Lucian BEZNEA

Ph. D. Thesis:

Teoria potenţialului - clasificări în conuri de potenţiale [*Potential Theory - Classifications in Cones of Potentials*], Universitatea din Bucureşti, 1990, 105 p.

Monographs:

L. Beznea and N. Boboc: *Potential Theory and Right Processes.* (Mathematics and Its Applications, vol. **572**), Kluwer Academic Publishers/Springer 2004, 376 p.

Edited Volumes:

1. L. Beznea and Gh. Bucur (editors): *Fifty Years of Modern Potential Theory in Bucharest – To the Anniversary of Nicu Boboc.* Editura Universităţii din Bucureşti, 2004.

2. D. Bakry, L. Beznea, Gh. Bucur, and M. Röckner (editors): *Current Trends in Potential Theory - Conference Proceedings, Bucharest, September 2002 and 2003.* The Theta Foundation, Bucharest 2005 (distributed by the Amer. Math. Soc).

3. D. Bakry, L. Beznea, N. Boboc, and M. Röckner (editors): *Potential Theory and Stochastics in Albac: Aurel Cornea Memorial Volume.* The Theta Foundation, Bucharest 2009 (distributed by the Amer. Math. Soc.).

4. L. Beznea, V. Brinzănescu, C. S. Calude, H. Ene, M. Iosifescu, S. Marcus, R. Purice, and D. Timotin (editors): *Proceedings of The Sixth Congress of Romanian Mathematicians, Bucharest, 2007. Volume 1, Scientific Contributions.* Editura Academiei Romane, Bucharest, 2009.

5. L. Beznea, V. Brinzănescu, M. Iosifescu, S. Marcus, and D. Timotin (editors): *Proceedings of The Sixth Congress of Romanian Mathematicians, Bucharest, 2007. Volume 2, Plenary Reports.* Editura Academiei Romane, Bucharest, 2009.

6. L. Beznea, A. Gheondea, P. Hästö, and M. Vuorinen (guest editors): : *Complex Anal. Oper. Theory* **5** (2011), no. 3. Special Issue: Trends in Modern Complex Analysis.

7. L. Beznea, V. Brinzănescu, M. Iosifescu, G. Marinoschi and R. Purice) (guest editors): *Proceedings of the Seventh Congress of Romanian Mathematicians.* (*Bulletin of the Transilvania University of Braşov* **5** (54) 2012, special issue) published by Transilvania University Press, Braşov and Publishing House of the Romanian Academy.

8. L. Beznea, V. Brinzănescu, M. Iosifescu, G. Marinoschi, R. Purice, and D. Timotin (editors): *Advances in Mathematics – Invited Contributions to the Seventh Congress of Romanian Mathematicians, Braşov, 2011.* The Publishing House of the Romanian Academy, Bucharest, 2013.

9. L. Beznea, A. Gheondea, P. Hasto, C. Joiţa, and M. Vuorinen (editors): *Selected papers from the International Conference on Complex Analysis and Related Topics, and the 13th Romanian-Finnish Seminar (26-30 June 2012)*, *Math. Reports* **15** (65), No. 4, 2013.

10. D. Bakry, L. Beznea, and M. Röckner (guest editors): *Revue Roumaine Math. Pures Appl.* **59**, No. 1, 2014 (Special issue dedicated to Professor Nicu Boboc on the occasion of his 80th birthday).

Scientific Publications:

1. L. Beznea: A topological characterization of complete distributive lattices. *Discrete Math.* **49** (1984), 117–120.
2. L. Beznea: Order completion condition for the cone of increasing continuous functions on an ordered compact space. *Revue Roumaine Math. Pures Appl.* **31** (1986), 183–187.
3. L. Beznea: Absolutely continuous potential kernels on homogeneous spaces. *St. Cercet. Mat.* **38** (1986), 264–283.
4. L. Beznea: Parabolic and elliptic parts in standard H-cones of functions. *Revue Roumaine Math. Pures Appl.* **32** (1987), 875–880.
5. L. Beznea: Ultrapotentials and positive eigenfunctions for an absolutely continuous resolvent of kernels. *Nagoya Math. J.* **112** (1988), 125–142.
6. L. Beznea: Potential type subordinations. *Revue Roumaine Math. Pures Appl.* **36** (1991), 115–135.
7. L. Beznea and N. Boboc: Balayages absorbants, paraboliques, elliptiques et quasi elliptiques dans la théorie du potentiel; relation avec la fonction de Green. *C.R. Acad. Sci. Paris,* t.**315**, Série I (1992), 685–688.
8. L. Beznea and N. Boboc: *Absorbent, parabolic, elliptic and quasielliptic balayages in potential theory.* Revue Roumaine Math. Pures Appl. **38** (1993), 197–234.
9. L. Beznea and N. Boboc: Absorbent, parabolic, elliptic and quasielliptic balayages in potential theory; II. *Revue Roumaine Math. Pures Appl.* **39** (1994), 197–210.
10. L. Beznea and N. Boboc: Absorbent, parabolic, elliptic and quasielliptic balayages in potential theory; relationships with the Green function. *Potential Analysis.* **4** (1995), 101–117.
11. L. Beznea and N. Boboc: Duality and biduality for excessive measures. *Revue Roumaine Math. Pures Appl.* **39** (1994), 419–438.
12. L. Beznea and N. Boboc: Excessive functions and excessive measures: Hunt's theorem on balayages, quasi-continuity. In *Class. and Modern Pot. Th. and Appl.*, NATO ASI Series C 430, Kluwer (1994), 77–92.
13. L. Beznea and L. Stoica: From diffusions to processes with jumps. In *Probability Theory and Mathematical Statistics.* Proceedings of the Sixth Vilnius Conference (1993). p. 53–74, TEV/VSP, The Netherlands, 1994.
14. L. Beznea and N. Boboc: On the integral representation for excessive measures. *Revue Roumaine Math. Pures Appl.* **40** (1995), 725–734.
15. L. Beznea and N. Boboc: Quasi-boundedness and subtractivity; applications to excessive measures. *Potential Analysis* **5** (1996), 467–485.
16. L. Beznea and N. Boboc: Once more about the semipolar sets and regular excessive functions. In *Potential Theory–ICPT 94*, Walter de Gruyter 1996, 255-274.
17. L. Beznea and N. Boboc: Représentations des balayages sur les mesures excessives et

versions de la propriété de Lindelöf. *C.R. Acad. Sci. Paris,* t.**322**, Série I (1996), 1033–1036.
18. L. Beznea and N. Boboc: Kuran's regularity criterion and localization in excessive structures. *Bull. London Math. Soc.* **28** (1996), 273–282.
19. L. Beznea and N. Boboc:Condensation points for the fine topology. *Analysis* **17** (1997), 13–23.
20. L. Beznea and N. Boboc: Balayages on excessive measures, their representation and the quasi-Lindelöf property. *Potential Analysis* **7** (1997), 805–825.
21. L. Beznea and L. Stoica: On the trajectories of stochastic evolution of interacting particle systems. *Revue Roumaine Math. Pures Appl.* **43** (1998), 521–531.
22. L. Beznea and N. Boboc: Noyaux fortement sumédians et mesures de Revuz. *C.R. Acad. Sci. Paris,* t. **327** (1998), Série I, 139–142.
23. L. Beznea and N. Boboc: Quasi bounded excessive functions and Revuz measures. In *Analysis and Topology* (A volume dedicated to the memory of S. Stoilow), World Scientific 1998, 151–163.
24. L. Beznea and N. Boboc: Feyel's techniques on the supermedian functionals and strongly supermedian functions. *Potential Analysis* **10** (1999), 347–372.
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27. L. Beznea and N. Boboc: Smooth measures and strongly supermedian kernels generating sub-Markovian resolvents. *Potential Analysis* **15** (2001), 77–87.
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49. L. Beznea and A.-G. Oprina: Bounded and L^p-weak solutions for nonlinear equations of measure-valued branching processes. *Nonlinear Analysis: Theory, Methods & Applications* **107** (2014), 34–46.
50. L. Beznea and M. Röckner: On the existence of the dual right Markov process and applications. *Potential Analysis* 2014, DOI 10.1007/s11118-014-9447-0.
51. L. Beznea and I. Cîmpean: On Bochner-Kolmogorov Theorem. In: *Séminaire de Probabilités XLVI* (Lecture Notes in Mathematics, Vol. 2123), Springer 2014, pp. 61–70.
52. L. Beznea, M. Deaconu, and O. Lupaşcu: Branching processes for the fragmentation equation. *Stochastic Processes and their Applications* 2014, doi:10.1016/j.spa.2014.11.016.
53. L. Beznea and O. Lupaşcu: Measure-valued discrete branching Markov processes. *Trans. Amer. Math. Soc.* 2014 (to appear).