MR2259928 (2007f:76025) 76B15

Dias, F. [Dias, Frédéric] (F-ENSET-AM); **Vanden-Broeck, J.-M.** (4-EANG)

Trapped waves between submerged obstacles. (English summary)

J. Fluid Mech. **509** (2004), 93–102.

This article considers two-dimensional free-surface potential flows past submerged obstacles. It builds on previous work by the authors [J. Engrg. Math. **42** (2002), no. 3-4, 291–301; MR1916643 (2003d:76018)] in which weakly nonlinear analysis and fully nonlinear computations were used to describe the possible types of solution when a single obstacle is present and the flow is required to be uniform in the far field. New solutions are computed for flow past two obstacles of arbitrary shape which are characterised by a train of waves "trapped" between the obstacles. When the distance between the obstacles is large, the flow in the vicinity of each obstacle is shown to reduce to solutions found for the single obstacle in the earlier paper.

Reviewed by *Chris M. Linton*

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MR2145933 01A70 (35-03)

Meyer, Yves (F-ENSET-AM)

Jean Leray et la recherche de la vérité. (French) [Jean Leray and the search for truth]

Actes des Journées Mathématiques à la Mémoire de Jean Leray, 1–12, *Sémin. Congr.*, 9, *Soc. Math. France, Paris*, 2004.

{This item will not be reviewed individually. For details of the collection in which this item appears see MR2145147 (2005m:35007) .}

{For the entire collection see MR2145147 (2005m:35007)}

AMERICAN MATHEMATICAL SOCIETY
MathSciNet Mathematical Reviews on the Web
Article

Citations
From References: 0
From Reviews: 0

MR2139695 (2006a:19003) 19D55 (16E40 19C20 19D45 20J06)
Ginot, Grégory (F-ENSET-AM)

Formules explicites pour le caractère de Chern en K-théorie algébrique. (French. English, French summaries) [Explicit formulas for the Chern character in algebraic K-theory]

Ann. Inst. Fourier (Grenoble) **54** (2004), *no. 7,* 2327–2355 (2005).

Let G be a group, $C_*(G)$ be the corresponding Eilenberg-Mac Lane complex and $\mathcal{B}C_*^-(\mathbf{Z}[G])$ be the negative cyclic homology of the group ring $\mathbf{Z}[G]$. In this paper, the author constructs an explicit chain map $C_*(G) \to \mathcal{B}C_*^-(\mathbf{Z}[G])$ inducing a functorial map $\Upsilon_*: H_*(G) \to HC_*^-(\mathbf{Z}[G])$. When applied to the group $G = \mathrm{GL}(A)$ of invertible square matrices (any size) with entries in a ring A, this construction yields explicit formulas for the Goodwillie-Jones universal algebraic Chern character $\mathrm{ch}_*^-: K_*(A) \to HC_*^-(A)$ from algebraic K-theory to negative cyclic homology of a ring. Thus it gives effective ways to study chain level operations.

Using this construction, the author gives an explicit formula in the first nontrivial case, namely $\mathrm{ch}_2^-: K_2(A) \to HC_2^-(A)$. There are important elements in $K_2(A)$ such as the Steinberg and Dennis-Stein symbols; he computes explicitly their Chern characters.

In higher degree, the author computes the images under the Chern character of other well-known symbols such as the Beilinson-Loday symbols and higher Steinberg symbols.

The technique he uses to construct Υ_* leads him to an elementary proof of the compatibility of the Chern character with products in algebraic K-theory and cyclic homology. Here the main interest is that it simplifies the computations, at the chain level, of the Chern character of a product.

Reviewed by *Gilles Halbout*

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MR2112129 (2005m:82064) 82B43 (28A80 60K35 60K40)

Desolneux, Agnès (F-ENSET-AM); **Sapoval, Bernard** (F-ENSET-AM); **Baldassarri, Andrea** (F-ENSET-AM)

Self-organized percolation power laws with and without fractal geometry in the etching of random solids. (English summary)

Fractal geometry and applications: *a jubilee of Benoît Mandelbrot*, *Part* 2, 485–505, *Proc. Sympos. Pure Math.*, 72, *Part* 2, *Amer. Math. Soc.*, *Providence*, *RI*, 2004.

The paper studies two percolation models: gradient percolation and etching gradient percolation.

The context of gradient percolation (GP) is a 2D square lattice of size $L_g \times L$, where each point (x, y) is occupied with probability $p(x) = 1 - x/L_g$. In gradient percolation there is always an infinite cluster of occupied sites as there is a region where p is larger than the standard percolation threshold p_c. There is also an infinite cluster of empty sites as there is a region where p is smaller than p_c. The object of interest is the GP front, the external limit of the infinite occupied cluster.

Another model studied in this paper is etching gradient percolation (EGP). In this model an etching solution is in contact with the initially flat surface of a disordered solid and starts to corrode its weakest regions. The model is defined as follows:

(i) A 2D random solid is represented as a site lattice (triangular or square), of linear width L and, possibly, infinite depth.

(ii) A random number $r_i \in [0, 1]$ (uniform $[0, 1]$) is assigned to each site i, representing its resistance to the etching by a corrosive solution. r_i does not depend on time (quenched disorder) or on the site environment.

(iii) The etching solution has a volume V and is initially in contact with the solid through the bottom boundary. It contains an initial number $N_{\text{et}}(0)$ of dissolved etching molecules. The "etching power" of the solution is supposed to be equal to $p(t) = N_{\text{et}}(t)/V$. At time-step t, all the interface sites with $r_i < p(t)$ are dissolved and a particle of etchant is consumed for each of these corroded solid sites.

In the paper the existing results on GP and EGP are discussed, some new exact results for the GP model and numerical results for both models are presented. More precisely, for GP with $L_g = 2$ and $L_g = 3$, on triangular and square lattices, the mean length, the mean position and the mean width of the front are calculated.

{For the entire collection see MR2112118 (2005g:28002)}

Reviewed by *Marina Vachkovskaia*

MR2109983 (2005h:37054) 37C45 (28A80 37D45)

Kolwankar, Kiran M. (F-ENSET-AM)

Decomposition of Lebesgue-Cantor devil's staircase. (English summary)

Fractals **12** (2004), *no. 4,* 375–380.

Summary: "We study the local oscillatory behavior of the Lebesgue-Cantor staircase function. The log-periodic oscillations at the points of the Cantor set are characterized exactly. It is shown that in the first approximation, the Lebesgue-Cantor staircase function can be written as the sum of power laws with imaginary exponents. Further approximations can be built using this series as a building block."

MR2098424 (2005f:76012) 76B15 (76B99)

Dias, Frédéric (F-ENSET-AM); **Vanden-Broeck, Jean-Marc** (F-ENSET-AM)

Two-layer hydraulic falls over an obstacle. (English summary)

Eur. J. Mech. B Fluids **23** (2004), *no. 6,* 879–898.

Summary: "Motions in a forced channel flow of two contiguous homogeneous fluids of different constant densities and different thicknesses are considered. The total depth is finite and the upper surface is constrained to be planar (rigid lid approximation). The forcing is due to a bottom obstruction. The existence of a critical thickness ratio, obtained when the square of the thickness ratio is equal to the density ratio, leads to major differences from the one-layer case. The present study concentrates on this critical case. Moreover it is restricted to hydraulic falls, which are steady flows over an obstacle providing a transition between a subcritical and a supercritical flow. A weakly nonlinear analysis is performed. At leading order the problem reduces to a forced modified Korteweg-de Vries equation which can be integrated exactly. The weakly nonlinear results are validated by comparison with a numerical integration of the full governing equations. The numerical method is based on boundary integral equation techniques. The differences with

the one-layer case are the existence of a second family of subcritical hydraulic falls when the thickness ratio is below critical, and the existence of supercritical hydraulic falls described by four parameters instead of three for all thickness ratios."

MR2089844 82C40 (35K55 82-02 82C31)
Desvillettes, L. (F-ENSET-AM); **Villani, C.** (F-ENSLY-PM)
Rate of convergence toward the equilibrium in degenerate settings. (English summary)
''*WASCOM* 2003''—12*th Conference on Waves and Stability in Continuous Media*, 153–165, *World Sci. Publ., River Edge, NJ*, 2004.

{This item will not be reviewed individually. For details of the collection in which this item appears see MR2089823 (2005c:00016) .}
{For the entire collection see MR2089823 (2005c:00016)}

MR2090130 (2005g:94020) 94A12 (49J52 68U10 90C30 90C31)
Nikolova, Mila (F-ENSET-AM)
Weakly constrained minimization: application to the estimation of images and signals involving constant regions. (English summary)
J. Math. Imaging Vision **21** (2004), *no. 2,* 155–175.

Summary: "We focus on the question of how the shape of a cost function determines the features manifested by its local (and hence global) minimizers. Our goal is to check the possibility that the local minimizers of an unconstrained cost function satisfy different subsets of affine constraints dependent on the data, hence the word 'weak'. A typical example is the estimation of images and signals which are constant on some regions. We provide general conditions on cost functions which ensure that their minimizers can satisfy weak constraints when noisy data range over an open subset. These cost functions are non-smooth at all points satisfying the weak constraints. In contrast, the local minimizers of smooth cost functions can almost never satisfy weak constraints. These results, obtained in a general setting, are applied to analyze the minimizers of cost functions, composed of a data-fidelity term and a regularization term. We thus consider the effect produced by

non-smooth regularization, in comparison with smooth regularization. In particular, these results explain the staircasing effect, observed in the application of total variation methods. Theoretical results are illustrated using analytical examples and numerical experiments."

Reviewed by *Patrick L. Combettes*

MR2090128 (2005d:68130) 68T45 (68U10 94A08)

Delon, Julie (F-ENSET-AM)

Midway image equalization. (English summary)

J. Math. Imaging Vision **21** (2004), *no. 2,* 119–134.

Summary: "Midway image equalization means any method giving to a pair of images the same histogram, while maintaining as much as possible their previous grey level dynamics. In this paper, we present an axiomatic analysis of image equalization which leads us to derive two possible methods. Both methods are then compared in theory and in practice for two reliability criteria, namely their effect on quantization noise and on the support of the Fourier spectrum. A mathematical analysis of the properties of the methods is performed. Their algorithms are described and they are tested on typical pairs such as satellite image stereo pairs and different photographs of the same painting."

MR2084259 (2005g:65175) 65N30 (49M25 58E20 90C53)

Pierre, Morgan (F-ENSET-AM)

Newton and conjugate gradient for harmonic maps from the disc into the sphere. (English summary)

ESAIM Control Optim. Calc. Var. **10** (2004), *no. 1,* 142–167 (*electronic*).

Let $B^2 = \{(x, y) \in \mathbf{R}^2,\ x^2 + y^2 < 1\}$, $S^2 = \{u \in \mathbf{R}^3,\ |u| = 1\}$ and $H^1_g(B^2, S^2) = \{u \in H^1(B^2, \mathbf{R}^3),\ |u| = 1$ a.e., $g \in C^1(\partial B^2, S^2),\ u|_{\partial B^2} = g$ in the sense of trace$\}$. In this paper

the author computes numerically the minimizers of the integral

$$\int_{B^2} |\nabla u|^2 dx$$

for $u \in H^1_g(B^2, S^2)$. In two appendices the Newton and the conjugate gradient algorithms for Riemann manifolds are introduced. Extensive numerical results are presented.

Reviewed by *R. Kodnár*

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Note: This list reflects references listed in the original paper as accurately as possible with no attempt to correct errors.

MR2073490 (2005f:76058) 76F99 (76B15 76D33 76X05)

Zakharov, Vladimir [Zakharov, Vladimir E.] (RS-AOS-L); **Dias, Frédéric** (F-ENSET-AM); **Pushkarev, Andrei**

One-dimensional wave turbulence. (English summary)

Phys. Rep. **398** (2004), *no. 1,* 1–65.

This paper presents a very interesting review of recent efforts devoted to numerical testing of the weak turbulence (WT) theory. This statistical theory of weakly nonlinear interacting dispersive waves, widely applied in the context of plasma physics and wind waves, assumes random phases and thus cannot be applied when coherent structures are formed. This paper discusses these limitations in detail in the case of one-dimensional model equations, and in particular revisits the numerical experiments presented in [A. J. Majda, D. W. McLaughlin and E. G. Tabak, J. Nonlinear Sci. **7** (1997), no. 1, 9–44; MR1431687 (97m:76071)]. This paper is self-contained as it recalls all the necessary background on WT theory and gives many details on the numerical experiments. Moreover, it contains interesting new developments on quasi-solitonic turbulence. The main result is that the window of applicability of WT theory is rather narrow. In general WT and strong turbulence, associated with the presence of solitons, quasi-solitons or collapses, coexist. This paper should be read by every researcher and student interested in WT theory.

Reviewed by *Thierry Passot*

MR2072030 (2005d:93017) 93B05 (35K20 93C20)

Phung, K.-D. (F-ENSET-AM)

Note on the cost of the approximate controllability for the heat equation with potential. (English summary)

J. Math. Anal. Appl. **295** (2004), *no. 2,* 527–538.

The author studies the controllability problem of a distributed control system described by a forced heat equation with potential posed on a bounded domain Ω in $\mathbf{R}^n$. The forcing function, as a control input, acts only on an open subset ω of Ω. The approximate controllability is established for the system with a cost of order $e^{c/\varepsilon}$ when the target is in $H_0^1(\Omega)$ and with precision in the $L^2(\Omega)$ norm. In addition, a quantification estimate of the unique continuation for the initial data in $L^2(\Omega)$ of the system without forcing is provided.

Reviewed by *Bing-Yu Zhang*

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Note: This list reflects references listed in the original paper as accurately as possible with no attempt to correct errors.

MR2049784 (2005b:94006) 94A08 (49J40 49J52 68U10 94A12)

Nikolova, Mila (F-ENSET-AM)

A variational approach to remove outliers and impulse noise. (English summary)

Special issue on mathematics and image analysis.
J. Math. Imaging Vision **20** (2004), *no. 1-2,* 99–120.

A method is proposed to detect outliers in signals and images corrupted by impulsive noise. A convex function of the form $\Psi_y(x)+\beta Q_y(x)$ with y the data and x the estimates is minimised. The first term is a non-smooth data fidelity term and the second is a smooth edge preserving regulation term. A convergent relaxation based method is proposed. Typically for $y \in \mathbf{R}^p$, one uses $\Psi_y(x) = \sum_{i=1}^p |x_i - y_i|$ and $Q_y(x) = \frac{1}{2}\sum_{i=1}^p \sum_{j\in N_i} \varphi(x_i - x_j)$, where N_i is a neighborhood of point i and $\varphi(t)$ could be, for example, $|t|^\alpha$, $1 < \alpha \leq 2$. The method gives a natural restoration: uncorrupted data are fitted exactly and outliers are replaced by values drawn from their neighbors.

Reviewed by *A. Bultheel*

MR2060456 (2005b:60263) 60K37 (60G50)

Brémont, Julien (F-ENSET-AM)

Random walks in random medium on $\mathbb{Z}$ and Lyapunov spectrum. (English, French summaries)

Ann. Inst. H. Poincaré Probab. Statist. **40** (2004), *no. 3,* 309–336.

The author considers a one-dimensional random walk with bounded steps in a stationary and ergodic random medium. He first obtains a precise description of the space of harmonic functions and proves a rather simple recurrence criterion similar to Key's theorem in terms of the sign of an intermediate Lyapunov exponent of a random matrix associated with the random walk. He proves also that this exponent is simple and proposes an algorithm to compute it. Finally, he proves that the law of large numbers is always valid for this type of random walk.

Reviewed by *Marc Peigné*

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MR2059669 (2005e:60235) 60K37 (37A50 60F05 60G50 82B41 82B44)

Bremont, Julien (F-ENSET-AM)

Behavior of random walks on $\mathbb{Z}$ in Gibbsian medium. (English, French summaries)

C. R. Math. Acad. Sci. Paris **338** (2004), *no. 11*, 895–898.

In this paper the author studies random walks on $\mathbb{Z}$ in a random environment with $\{-L, \ldots, -1, 0, 1\}$ $(L \geq 1)$ as possible jumps. Under the assumption that the environment is defined by a Gibbsian measure on a subshift of finite type, the author proves that there is a dichotomy in the recurrent case between the pointwise functional CLT and the slow behavior described by Sinai; in the transient case under natural integrability conditions, the author proves the validity of the averaged CLT.

Reviewed by *Wan Ding Ding*

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MR2057517 (2004m:76160) 76T10 (35Q35 76M25 80M25)

Baranger, C. (F-ENSET-AM)

Modelling of oscillations, breakup and collisions for droplets: the establishment of kernels for the T.A.B. model. (English summary)

Math. Models Methods Appl. Sci. **14** (2004), *no. 5,* 775–794.

Summary: "In this work, we consider a spray consisting of droplets surrounded by a gas. The droplets are described by a kinetic equation and the gas satisfies an equation of fluid dynamics such as Navier-Stokes. We write down the kernels corresponding to complex phenomena such as oscillations, breakup and collisions/coalescences. We use for that the T.A.B. model of oscillations introduced in particular in the KIVA code of combustion of Los Alamos, and the collision model introduced by Villedieu. We briefly explain the numerical method for solving such equations, and present results."

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Note: This list reflects references listed in the original paper as accurately as possible with no attempt to correct errors.

MR2049572 (2005b:60097) 60G15 (60G17 60G18)

Ayache, Antoine (F-ENSET-AM); **Lévy Véhel, Jacques** (F-INRIA)

On the identification of the pointwise Hölder exponent of the generalized multifractional Brownian motion. (English summary)

Stochastic Process. Appl. **111** (2004), *no. 1,* 119–156.

Fractional calculus has been found to be useful in modeling complex natural phenomena. In particular, fractional stochastic processes have received much attention for their use in applications in physics, engineering and economics. An example of this is the fractional Brownian motion (FBM) first introduced by Kolmogorov in 1940. The importance of this was emphasized by Mandelbrot and Van Ness in 1968. The present paper gives an excellent introduction and background of FBM and its generalization to multifractional Brownian motion (MBM). FBM is a continuous and centered Gaussian process denoted by $B_H(t)$, $t \in \mathbf{R}^d$ (equation (1.1)). It depends on one parameter $H \in (0,1)$, known as the Hurst parameter. It is important to note that when $H = 1/2$, FBM reduces to Brownian motion. Also, the pointwise Hölder exponent, denoted by $\alpha_{BH}(t)$ $(t \in \mathbf{R}^d)$, is given by its Hurst parameter H. For MBM denoted by $Z(t)$ $(t \in \mathbf{R}^d)$ the pointwise Hölder exponent is given by $\alpha_z(t) = H(t)$. This paper considers the generalized multifractional Brownian motion (GMBM) which is a continuous Gaussian process and identifies the associated pointwise Hölder function $H(t)$. Using the method of generalized quadratic variations the authors obtain an interesting result: As soon as the pointwise Hölder function of GMBM belongs to the first Baire class (i.e. when $H(\cdot)$ is a limit of continuous functions) one may estimate it at any point t almost surely. A central limit theorem is shown to hold for the estimator. The results are illustrated nicely using both simulated and real data.

The paper is characterized by its lucid presentation and adequate mathematical terminology and rigor. It illustrates clearly the use of generalized multifractional Brownian motion.

Reviewed by *Suresh V. Lawande*

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MR2047146 (2005e:35014) 35B27 (35Q72 74Q05)

Courilleau, P. (F-CEPO); **Mossino, J.** (F-ENSET-AM)

Compensated compactness for nonlinear homogenization and reduction of dimension. (English summary)

Calc. Var. Partial Differential Equations **20** (2004), *no. 1,* 65–91.

The authors consider the simultaneous reduction of dimension and homogenization for general nonlinear boundary value problems for monotone equations of the second order in a thin domain in $\mathbf{R}^n$, assuming a natural convergence of source terms and compensated compactness properties for the coefficients, in addition to coercivity, growth and monotonicity conditions. They prove that a limit problem (when a small parameter, the thickness of the domain in a transversal subspace,

tends to zero) has the same form. The paper extends a recent result of B. Gustavsson and the second author [IMA J. Appl. Math. **68** (2003), no. 3, 269–298; MR1984565 (2004b:35020)] for the linear case and transversal dimension $n-1$.

Reviewed by *I. Aganović*

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MR2045230 (2005d:82070) 82C10 (35Q55 82-02)

Bardos, Claude (F-ENSET-AM); **Golse, François** (F-ENS); **Gottlieb, Alex** (A-WIEN); **Mauser, Norbert J.** (A-WIEN)

On the derivation of nonlinear Schrödinger and Vlasov equations. (English summary)

Dispersive transport equations and multiscale models (*Minneapolis, MN*, 2000), 1–23, *IMA Vol. Math. Appl.*, 136, *Springer, New York*, 2004.

Summary: "We present and discuss derivations of nonlinear 1-particle equations from linear N-particle Schrödinger equations with pair interaction in the time-dependent case.

"We consider both the 'classical' limit of vanishing Planck constant $\hbar \to 0$, which leads to Vlasov type equations, and the 'weak coupling' limit $1/N \to 0$, which leads to nonlinear 1-particle equations.

"We use an approach to weak coupling limits where the so-called 'finite Schrödinger hierarchy' and the limiting '(infinite) Schrödinger hierarchy' play a central role. Convergence of solutions of the first to solutions of the second is established using 'physically relevant' estimates (L^2 and

energy conservation) under very general assumptions on the interaction potential, including, in particular, the Coulomb potential.

"The goal of this work is to give an overview of the existing results, including some minor improvements, and to clearly state the open problems."

{For the entire collection see MR2045161 (2004j:82001)}

MR2038147 (2004k:82086) 82C40 (35B65 35F20 76P05)

Desvillettes, Laurent (F-ENSET-AM); **Wennberg, Bernt** (S-CHAL)

Smoothness of the solution of the spatially homogeneous Boltzmann equation without cutoff. (English summary)

Comm. Partial Differential Equations **29** (2004), *no. 1-2*, 133–155.

This paper describes regularizing effects of the non cut-off Boltzmann equation. Precisely, the authors consider the spatially homogeneous Boltzmann equation and take into account a singularity of the collision kernel for small deflection angle. (However, there remain some restrictions on the dependence of the kernel with respect to the relative velocity of the colliding particles.) The initial data is only assumed to have finite mass, energy and entropy. Then the solution of the Boltzmann equation lies for any strictly positive time in the Schwartz space.

Reviewed by *Thierry Goudon*

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MR2035519 (2004m:92008) 92C20 (34D08 37N25)

Brette, Romain (F-ENSET-AM)

Dynamics of one-dimensional spiking neuron models. (English summary)

J. Math. Biol. **48** (2004), *no. 1,* 38–56.

This paper investigates an abstract model of a spiking neuron, embedding the numerous variants of the original leaky integrate-and-fire model into a generalized one. It provides a rigorous mathematical analysis of generic properties exhibited by dynamical systems with threshold and reset, satisfying either of two generic hypotheses, namely (i) the dynamics is leaky, (ii) trajectories re-

main above the reset level. The neural response to various inputs is studied through the "spike map" φ giving the time $\varphi(t)$ of the spike following one at time t. It allows one to define a firing rate and for instance, to study the conditions of phase locking, in case of a periodic input. Among many other results, it is shown that under either of the above hypotheses, sustained firing and its firing rate do not depend on the initial conditions. Occurrence of chaos requires that both conditions (i) and (ii) fail.

This study might appear as a mathematical work quite far from real neurons but it also really deserves attention from the biological viewpoint: by assessing general (and exact) properties that could not be avoided nor circumvented, it gives a mathematical framework, guidelines and landmarks for any further modeling which is intended to account for specific biological data. The mathematical emphasis of this paper should not deter readers interested in neurobiological issues.

Reviewed by *Annick Lesne*

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MR2033100 (2004k:82085) 82C40 (60K35 82C31)
Desvillettes, L. (F-ENSET-AM); **Ricci, V.** (I-ROME)
Non-Markovianity of the Boltzmann-Grad limit of a system of random obstacles in a given force field. (English summary)
Bull. Sci. Math. **128** (2004), *no. 1*, 39–46.

Summary: “In this paper we consider a particle moving in a random distribution of obstacles. Each obstacle is absorbing and a fixed force field is imposed. We show rigorously that certain (very smooth) fields prevent the process obtained by the Boltzmann-Grad limit from being Markovian. Then we propose a slightly different setting which allows this difficulty to be removed.”

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