I - Curriculum Vitae – Philippe Roux

Etat Civil

Philippe ROUX, résidant : 26, rue Raoul Blanchard
né le 10 février 1969 à Lyon (Rhône) 38000 Grenoble
marié, six enfants

Formation

2001	Habilitation à Diriger les Recherches, Université Paris VI.
1997	Thèse de Doctorat de l'Université Paris VI, spécialité Physique des Liquides.
1989	Entrée à l'Ecole Normale Supérieure.

Activités professionnelles

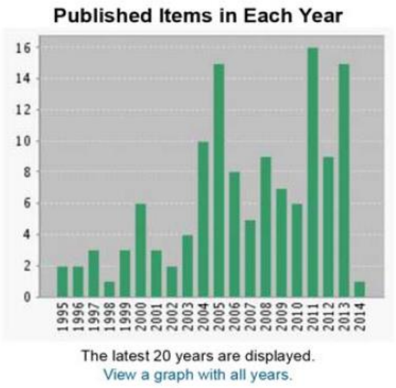
Oct. 2009	Directeur de Recherche DR2 à ISTerre.
Juil. 2005	Chargé de Recherche CR1 à ISTerre, UMR 5275, Grenoble.
Jan. 2002	Visiting scientist puis Research Associate (tenured position) au MPL (USA).
Dec. 1998	Chargé de Recherche CNRS (CR2, puis CR1 en octobre 2001) au LOA.
Sept. 1997	Post-doc au Marine Physical Laboratory (MPL), Scripps Institution of Oceanography, University of California San Diego, USA.
Avril 1997	Thèse au Laboratoire Ondes et Acoustique (LOA), UMR 7587, Paris.

Distinctions

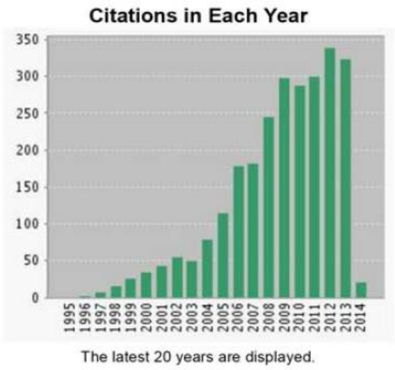
2013	Medwin Prize in Acoustical Oceanography.
2012	Excellence in Refereeing for Journal of Geophysical Research- Solid Earth (JGR).
2010	Prime d'Excellence Scientifique.
2009	Best Paper Award of the EAGE.
2005	Chaire d'Excellence Junior (ANR).
2004	Fellow of the Acoustical Society of America.

Publications et Citation index (Mars 2014)

- 129 articles dans des journaux à comité de lecture (rang A), 2 chapitres de livre, 37 actes de conférences internationales, >140 participations orales dans des congrès internationaux dont 20 conférences invitées.
- Citation index = 2615, h-index = 26, < h > = 20.1 (Source ISI Web of Knwoledge)



The latest 20 years are displayed.
View a graph with all years.



The latest 20 years are displayed.

Results found: 130
Sum of the Times Cited [?] : 2615
Sum of Times Cited without self-citations [?] : 2294
Citing Articles: [?] : 1464
Citing Articles without self-citations [?] : 1362
Average Citations per Item [?] : 20.12
h-index [?] : 26

Points marquants sur la période 2010-2014

Fellow de l'Acoustical Society of America (2004), j'ai été promu Directeur de Recherche au CNRS en 2009. Depuis avril 2012, j'assume la direction de l'équipe Ondes et Structure (50 personnes, dont 17 chercheurs permanents et 7 ITA) au sein d'ISTerre. J'ai reçu le Medwin Prize in Acoustical Oceanography en 2013. Je fais partie de l'équipe lauréate du Grand Prix de l'Académie des Sciences (Prix Del Duca) en 2013.

Mobilité thématique

J'ai été recruté au CNRS (en 1998) en section 5 sur un thème de recherche lié à la « propagation d'ondes en milieu complexe ». C'est aussi la section 5 qui m'a promu directeur de recherche en 2009 suite à mon retour à Grenoble après plusieurs années passées aux USA (2002-2005). Depuis quelques années, cependant, mes axes de recherche correspondent mieux aux thématiques naturelles de la section 9, avec une prédilection pour « l'imagerie et le monitoring sismo-acoustique ». Même si ces deux sections partagent beaucoup de thèmes communs la section 5 est plutôt orientée « matière » et la 9 plutôt « ondes ». La section 9 présente aussi une préférence pour la physique appliquée qui me correspond parfaitement en tant que physicien expérimentateur. Ce sont ces différences qui ont motivé mon changement de section en 2012, ainsi que le rattachement de notre unité (ISTerre) à l'INSIS. Ce changement de section correspond donc à une évolution thématique progressive de ma carrière de physicien, en accord avec mon appartenance avec un laboratoire clairement orienté vers les sciences de la terre.

II- Summary of Research Activity – 2010-2014 - Philippe Roux

Since my arrival in Grenoble (2005), my research activity is organized around two principal subjects:

1- The use of seismic ambient noise to image and monitor the Earth structure.

2- The use of advanced array processing in underwater acoustics to perform tomography and target detection/localization in shallow water.

As illustrated below with references to my publication list (each reference number corresponds to the relevant paper), this work was mostly performed from data analysis collected on arrays of receivers and laboratory scale experiments. The two following sections summarize the main goal of this research.

1- Seismic noise processing: a new way toward imaging and monitoring of the Earth structure.

The surface of the Earth is continuously vibrating, mainly because of the effect of the swell in the oceans but also because of the human activity. This low amplitude signals known as ambient seismic noise propagate through every point of the Earth and are continuously recorded at numerous places by modern seismic networks. We have shown recently that these records could be used to build virtual seismograms. With long records of the ambient noise at two stations, we can easily compute the two-point correlation to retrieve the signal that would be produced at one station if a source were acting at the other. We use this principle to image the Earth at different scale and to monitor continuously the velocity of seismic waves at depth [22]. Refined signal processing techniques provides the detection of very small variations in the velocity of the propagating wave that are indicative of slight changes in the physical state of the rocks [11].

Because the processing relies on ambient seismic noise, we study the physical mechanism that generates this noise, namely the interaction of oceanic waves with the solid Earth. We use seismic antenna to locate the noise sources in the ocean and oceanographic models to describe the behavior of the swell [26]. We develop mathematical and numerical method to process the huge quantity of data that are nowadays generated by the seismic networks. This is made possible by modern storage capabilities and distributed computing.

We performed high-resolution surface imaging based on noise correlation. This approach was widely used since our first work with hundreds of papers published since 2004. We recently improved the quality of imaging by using array-processing techniques such as double beam forming or inverse filtering [7, 10, 16, 19, 23, 25].

We obtained in 2008 the ERC advanced grant WHISPER to develop new tools to monitor the Earth deformations with the objective of understanding natural phenomena associated with dangerous hazards. For example, we found signals that precede volcanic eruptions or landslides and studied the changes that accompany the earthquakes and that give new clues on the mechanical behavior of the subsurface [14, 20, 28, 40]. Also, we study the crust at the time of a slow slip event that is a silent earthquake detected by geodetic measurement only [30]. Nevertheless we observed in Mexico that the properties of the rocks at depth also change during the slow slip. It indicates that the rock properties are not only sensitive to the shaking by strong waves produced by the large earthquakes, but also to the deformation produced at depth by the different kinds of tectonic motions. Seismology could provide information on the non-elastic behavior of the crust, a key issue to understand the earthquake process and the seismic cycle. We are working on different approaches to decipher and locate the different processes that contribute to the change. This is a new field of continuous observations. At the same time, we have developed a well-equipped acoustic laboratory where we perform small-scale experiments. We study the physics of wave propagation in complex media and we test the configurations and the processing algorithms that we apply at large scale [12, 34].

In conclusion, we developed new, efficient, cost-effective techniques to image and to monitor slight changes at depth. They open the way to a renewed vision of the processes at depth at time scales between days and tens of years. These techniques can be applied at different scales. They provide the measure of potentially dangerous natural processes such as earthquakes, landslides or volcanic eruptions. They may also prove useful in industrial contexts. In particular, ambient noise can be used to image the shallow layers in exploration geophysics or to monitor the mechanical behavior of the rocks around underground repositories during the exploitation of natural resources or during gas sequestration [29, 35, 39, 41].

2- Underwater acoustics: shallow water tomography through advanced array processing

We performed acoustic tomography as well as target detection and localization in a shallow ultrasonic waveguide at the laboratory scale between two source–receiver arrays. At a 1/1000 scale, the waveguide represents a 1.1-km-long, 52-m-deep ocean acoustic channel in the kilohertz frequency range. Two coplanar arrays record the transfer matrix in the time domain of the waveguide between each pair of source–receiver transducers. A time-domain, double-beamforming algorithm is simultaneously performed on the source and receiver arrays that projects the multi-reflected acoustic echoes into an equivalent set of eigenrays, which are characterized by their travel times and their launch and arrival angles [31]. When a thermal plume is generated at a given location in the waveguide, travel-time differences are measured for each eigenray every 0.1 s. Travel-time tomography inversion is then performed using two forward models based either on ray theory or on the diffraction-based sensitivity kernel. The spatially resolved range and depth inversion data confirm the feasibility of acoustic tomography in shallow water [17]. Similarly, in the presence of a target in the waveguide, comparison is made between the intensity of each eigenray without and with a target. Localization is performed through tomography inversion of the acoustic impedance of the target, using all of the eigenrays extracted from double beamforming. The use of the diffraction-based sensitivity kernel for each eigenray provides both the localization and the signature of the target [6].

Using the Born approximation, we developed a linearized sensitivity kernel to describe the relationship between a local change in the water column or at the free surface and its effect on the acoustic propagation [24, 43, 44, 45]. The structure of the surface scattering kernel is investigated numerically and experimentally for the case of a waveguide at the ultrasonic scale. To better demonstrate the sensitivity of the multipath propagation to the introduction of a localized perturbation at the air-water interface, the kernel is formulated both in terms of point-to-point and beam-to-beam representations. The agreement between theory and experiment suggests applications to sensitivity analysis of the wavefield for sea surface perturbations [50].

For acoustic propagation through a shallow ocean channel or waveguide, the coherence between different transmissions is controlled primarily by the roughness of the ocean surface and to a lesser degree by fluctuations in the volume. We defined the coherent-to-incoherent intensity ratio (CTIR) as a way to quantify the coherence between multipath transmissions and ocean surface rms wave height and wind speed. The CTIRs have been evaluated over a period of several days using broad-band experimental results from shallow-water deployment of source and receiver arrays that span most of the water column. Estimates of wind speed and rms wave height obtained using these CTIR calculations are compared with environmental measurements to demonstrate the validity of the theory [2].

Finally, using ocean ambient noise recordings in a similar way as seismic ambient noise, we showed the possibility to approximate the time domain Green's function between arrays of hydrophones and to extract the time delays associated with different ray paths [18, 33, 36]. Analysis of the noise-extracted Green’s function gives accurate environmental detail, specifically the critical angle at the water-sediment interface.

III- Research Projects

My research projects in the next ten years are strongly dominated by the analysis of noise coherence in geophysics and underwater acoustics, coupled with the use of array processing to perform imaging and monitoring of the ocean and/or the Earth structure. As expected from my ultrasonic background, some of these research projects will be performed using experimental configurations at the laboratory scale.

We are at the time of a major breakthrough in seismology. Our first goal is the body wave imaging of the global Earth with ambient noise. We found recently that it is possible to construct virtual seismograms between stations for the arrivals that propagate across the deepest structures like the core [41]. These seismograms could be used to fill the gaps left by the uneven distribution of earthquakes in traditional seismology. We plan to image the deep structures with the new observations provided by the ambient noise. We will use advanced array processing when possible to improve the signal to noise ratio. The emergence of surface wave ambient noise tomography has improved our models of crust and lithosphere. Ambient noise body wave imaging is expected to provide similar improvements for the deep structures.

We will apply ambient noise monitoring as a tool to complement geodetic techniques for the study of deformation in fault zones and volcanoes. We will reduce the temporal resolution of our measurements and identify the different sources of speed variations to build a strategy of correction of superficial effects. We will rely on numerical simulation to compute the sensitivity kernel that will be used to locate the changes in 3D. Our goal is to take advantage of the spatial and temporal resolution of seismic measurements to study the mechanical behavior of the crust in relation with hazardous phenomena like earthquakes and volcanoes. We propose to deploy two dense arrays on the Piton de la Fournaise volcano to test advanced array processing in the context of one of the most active volcanoes.

Imaging the 3D deformation in the vicinity of a dynamically growing crack is made possible with slid/slip experiment with gels. We will use a technique called “Ultrafast ultrasonic speckle interferometry”, and initially developed for medical imaging, to image the bulk of a sliding block of gel under various friction conditions. With this experimental ‘fracture imaging device’ we could infer the dynamic deformation field in relation with the heterogeneities of the friction surface. It would make possible to perform the large number of friction experiments which are necessary to assess statistical properties of the rupture.

In the next two years, these projects will be funded by the “Grand Prix de l’Académie des Sciences” obtained by our team in 2013 (Project Leader: Michel Campillo). I intend to compete for ERC Senior Grant in 2014.

IV- Publications dans des revues de rang A (période 2010-2014)

52-H. Zhang, M. Maceira, P. Roux, and C. Thurber, Joint Inversion of Body-Wave Arrival Times and Surface-Wave Dispersion for Three-Dimensional Seismic Structure Around SAFOD, in press, Pure and Applied Geophysics, 2014

51- S. Yildiz, P. Roux, S. Rakotonarivo, C. Marandet, and W. A. Kuperman, Target localization through a data-based sensitivity kernel: A perturbation approach applied to a multistatic configuration, in press, J. Acoust. Soc. Am., 2014.

50- P. Roux and B. Nicolas, Inverting for a deterministic surface gravity wave using the sensitivity-kernel approach, in press, J. Acoust. Soc. Am., 2014

49- P. Boue, M. Campillo, P. Poli and P. Roux, Reverberations, coda waves and ambient noise: correlations at the global scale and retrieval of the deep phases, in press, Earth and Planetary Science Letter, 2014

48- P. Boué, P. Roux, M. Campillo and Xavier Briand, Phase velocity tomography of surface waves using ambient noise cross-correlation and array processing, in press, J. Geophys. Res., 2014.

47- M. Campillo and P. Roux, Seismic imaging and monitoring with ambient noise correlations, Treatise on Geophysics, second Edition, Vol. 1, Edited by B. Romanowicz and A. Dziewonski, 2014.

46- P. Roux and Y. Ben Zion, Geophys. J. Int. 196, 1073-1081, 2014.

45- A. Colombi, L. Boschi, P. Roux, and M. Campillo, J. Acoust. Soc. Am. 135, 1034, 2014.

44- F. Aulanier, P. Roux, B. Nicolas, R. Brossier, and J. Mars, J. Acoust. Soc. Am., 134, EL373-379, Sept. 2013.

43- F. Aulanier, B. Nicolas, P. Roux, and J. Mars, J. Acoust. Soc. Am., 134(1), 88-96, July 2013.

42- P. Roux, C. Marandet, B. Nicolas, and W. A. Kuperman, J. Acoust. Soc. Am., 134(1), EL38-44, July 2013.

41- P. Boué, P. Poli, M. Campillo, H. Pedersen, X.Briand and P. Roux, Geophys. J. Int. 194, 844-848, Aug 2013.

40- A. Mordret, N. M. Shapiro, S. Singh, P. Roux, J.-P. Montagner and O. I. Barkved, Geophys. Res. Lett., doi: 10.1002/grl.50447, April 2013.

39- J. Vandemeulebrouck, P. Roux and Estelle Cros, Geophys. Res. Lett., doi: 10.1002/grl50422, March 2013.

38-A. Mordret, M. Landès, N. M. Shapiro, S. Singh, P. Roux and O. I. Barkved, Geophys. J. Int. doi: 10.1093/gji/ggt061, March 2013.

37- P. Roux, W.A. Kuperman, Bruce D. Cornuelle, F. Aulanier, W.S. Hodgkiss and H. C. Song, J. Acoust. Soc. Am. 133, pp. 1945-1952, April 2013.

36- P. Boue, P. Roux, M. Campillo and B. de Cacqueray, Geophysics, 78 (3), V101-V108, May 2013.

35-S. W. Lani, K. G. Sabra, W.S. Hodgkiss, W. A. Kuperman and P. Roux, J. Acoust. Soc. Am. Express Letters 133, EL108-113, Feb 2013.

34- A. Mordret, N. M. Shapiro, S. S. Singh, P. Roux and O. I. Barkved, Geophysics, 78, March 2013.

33- B. de Cacqueray, P. Roux, M. Campillo, and S. Catheline, Geophysics 78, Jan. 2013.

32- M. Ali, P. Guéguen, P.-Y. Bard, P. Roux and M. Langlais, Bull seism. Soc. Am., 103(1), pp. 236-246, doi 10.1785/0120120048, 2013.

31- G. Le Touze, B. Nicolas, J. I. Mars, P. Roux and B. Oudompheng, 2012:187, August 2012.

30- D. Zigone, D. Rivet, M. Radiguet, M. Campillo, C. Voisin, N. Cotte, A.Walpersdorf, N. M. Shapiro, G. Cougoulat, P. Roux, V. Kostoglodov, A. Husker, J. S. Payero, J. Geophys. Res., 117, B09304, Sept. 2012

29- M. Corciulo, P. Roux, M. Campillo, D. Dubucq and W. A. Kuperman, Geophysics, 77, 33-41, Sept. 2012.

28- M. Corciulo, P. Roux, M. Campillo and D. Dubucq, Geophysics, 77, 37-44, July. 2012.

27- C. Leroy, S. Lani, K. Sabra, W. Hodgkiss, W. Kuperman, and P. Roux, J. Acoust. Soc. Am., 132 (2), 883-893, August 2012.

26- Hillers G, Campillo M, Lin YY, Ma KF and Roux P., J. Geophys. Res., 117, 6301, June 2012.

25- J. Letort, P. Roux, J. Vandemeulebrouck, Olivier Coutant, Estelle Cros Marc Wathelet, C. Cardellini and R. Avino, Pozzuoli, Geophys. J. Int., 189 (3), 1725-1733, June 2012

24- J. Sarkar, C. Marandet, P. Roux, S. Walker, B.D. Cornuelle and W.A. Kuperman, J. Acoust. Soc. Am., 131 (1), 111-118, Jan. 2012.

23- T. Gallot, S. Catheline, P. Roux, and M. Campillo, J. Acoust. Soc. Am., 131(2), EL21-27, Jan. 2012.

22- M. Campillo, P. Roux and N. M. Shapiro, Harsh K. Gupta (ed), Springer, 1230-1235, 2011.

21- S.T. Rakotonarivo, S.C Walker, W.A. Kuperman and P. Roux, J. Acoust. Soc. Am., 130(6), 3566-3573, Nov. 2011.

20- E. Cros, P. Roux, J. Vandemeulebrouck and S. Kedar, Geophys. J. Int., 187(1), 385-393, Oct. 2011.

19- B. Froment, M. Campillo and P. Roux, Compte Rendu de l'Académie des Sciences, 343, 623-632, Oct. 2011.

18- P. Roux, W.A. Kuperman and K. G. Sabra, Compte Rendu de l'Académie des Sciences, 343, 533-547, Oct. 2011.

17- P. Roux, Ion Iturbe, B. Nicolas, J. Virieux and J. Mars, J. Acoust. Soc. Am., 130(3), 1232-1241, Sept. 2011.

16- P. Roux, A. Roueff and Marc Wathelet, Geophys. Res. Lett., 38, L13319, July 2011.

15- P. Roux, C. Marandet, Patrick La Rizza and W.A. Kuperman, J. Acoust. Soc. Am., 130 (1), 13-19, July 2011.

14- S. Durand, J.P. Montagner, P. Roux, F. Brenguier, R.M. Nadeau and Y. Ricard, Geophys. Res. Lett., 38, L13303, July 2011.

13- J. Bonnel, C. Gervaise, P. Roux, B. Nicolas and J. Mars, J. Acoust. Soc. Am., 130 (1), 61-71, July. 2011.

12- B. De Caqueray, P. Roux, M. Campillo, S. Catheline and P. Boue, Journal of Applied Geophysics, 74, 81-88, July 2011

11- C. Hadziioannou, E. Larose, A. Baig, P. Roux and M. Campillo, J. Geophys. Res., 116, B07304, doi:10.1029/2011JB008200, July 2011.

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