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Marie Farge CNRS-INSMI ENS Paris

January 19<sup>th</sup> 2017 KITP (Kavli Institute of Theoretical Physics) University of California at Santa Barbara

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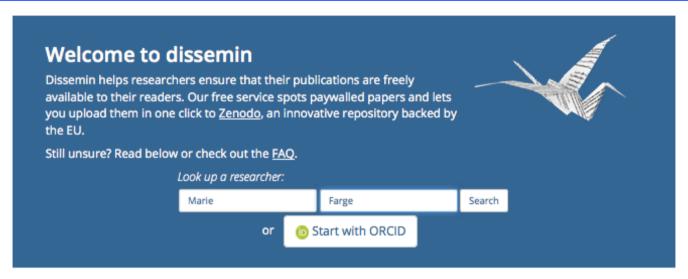


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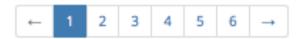
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Frank G. Jacobitz, Kai Schneider, Wouter J. T. Bos, Marie Farge

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Marie Farge, Kai Schneider

2015

Wavelet transforms and their applications to MHD and plasma turbulence: a review

◆ Download | Cambridge University Press (CUP), Journal of Plasma Physics, 06(81), 2015.

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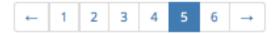
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Kai Schneider, Marie Farge

Coherent Vortex Simulation (CVS) of 2D bluff body flows using an adaptive wavelet method with penalisation

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Bartosz Protas, Kai Schneider, Marie Farge

2002

Geometrical alignment properties in Fourier- and waveletfiltered statistically stationary two-dimensional turbulence

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Kai Schneider, Marie Farge

Adaptive Wavelet Simulation of a Flow around an Impulsively Started Cylinder Using Penalisation

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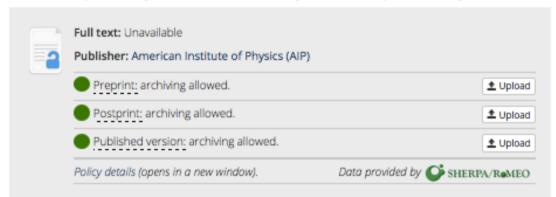
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# Coherent vortex extraction in three-dimensional homogeneous turbulence: Comparison between CVS-wavelet and POD-Fourier decompositions

Journal article by Marie Farge, Kai Schneider, Giulio Pellegrino, Alan A. Wray, Robert S. Rogallo



### Abstract

The coherent vortex simulation (CVS) decomposes each realization of a turbulent flow into two orthogonal components: An organized coherent flow and a random incoherent flow. They both contribute to all scales in the inertial range, but exhibit different statistical behaviors. The CVS decomposition is based on the nonlinear filtering of the vorticity field, projected onto an orthonormal wavelet basis made of compactly supported functions, and the computation of the induced velocity field using Biot-Savart's relation. We apply it to a three-dimensional homogeneous isotropic turbulent flow with a Taylor microscale Reynolds number R λ =168, computed by direct numerical simulation at resolution N=256 3 . Only 2.9%N wavelet modes correspond to the coherent flow made of vortex tubes, which contribute 99% of energy and 79% of enstrophy, and exhibit the same k -5/3 energy spectrum as the total flow. The remaining 97.1%N wavelet modes correspond to a incoherent random flow which is structureless, has an equipartition energy spectrum, and a Gaussian velocity probability distribution function (PDF). For the same flow and the same compression rate, the proper orthogonal decomposition (POD), which in this statistically homogeneous case degenerates into the Fourier basis, decomposes each flow realization into large scale and small scale flows, in a way similar to large eddy simulation(LES) filtering. It is shown that the large scale flow thus obtained does not extract the vortex tubes equally well as the coherent flow resulting from the CVS decomposition. Moreover, the small scale flow still contains coherent structures, and its velocity PDF is stretched exponential, while the incoherent flow is structureless, decorrelated, and its velocity PDF is Gaussian. Thus, modeling the effect of the incoherent flow discarded by CVS-wavelet shall be easier than modeling the effect of the small scale flow discarded by POD-Fourier or LES.

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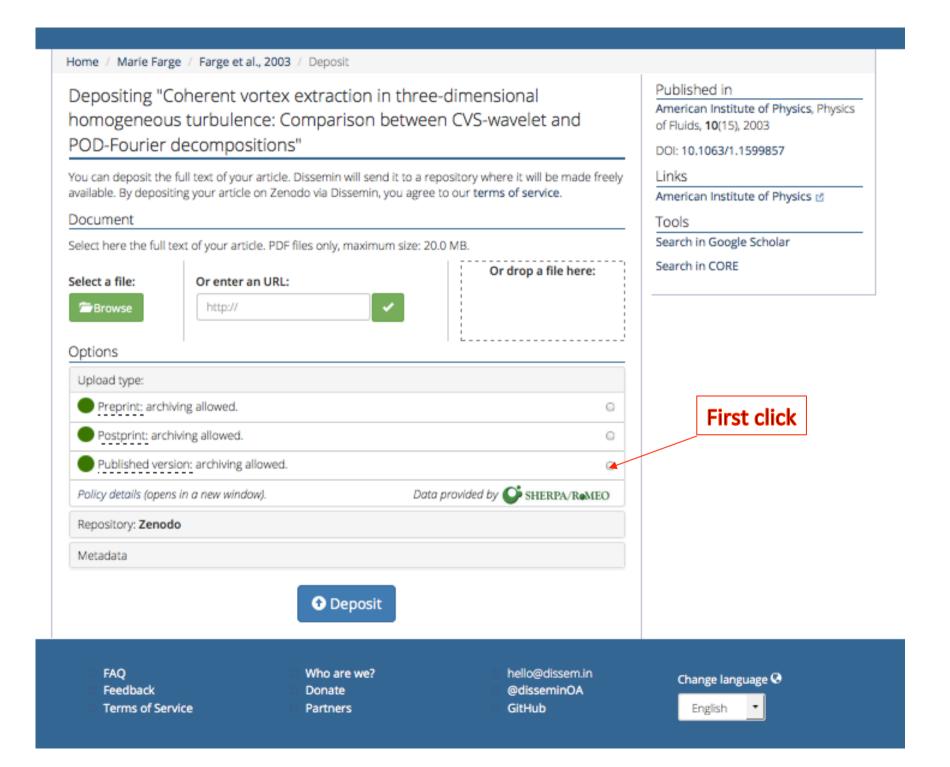
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The coherent vortex simulation (CVS) decomposes each realization of a turbulent flow into two orthogonal components: An organized coherent flow and a random incoherent flow. They both contribute to all scales in the inertial range, but exhibit different statistical behaviors. The CVS decomposition is based on the nonlinear filtering of the vorticity field, projected onto an orthonormal wavelet basis made of compactly supported functions, and the computation of the induced velocity field using Biot-Savart's relation. We apply it to a three-dimensional homogeneous isotropic turbulent flow with a Taylor microscale Reynolds number R λ =168, computed by direct numerical simulation at resolution N=256 3 . Only 2.9%N wavelet modes correspond to the coherent flow made of vortex tubes, which contribute 99% of energy and 79% of enstrophy, and exhibit the same k -5/3 energy spectrum as the total flow. The remaining 97.1%N wavelet modes correspond to a incoherent random flow which is structureless, has an equipartition energy spectrum, and a Gaussian velocity probability distribution function (PDF). For the same flow and the same compression rate, the proper orthogonal decomposition (POD), which in this statistically homogeneous case degenerates into the Fourier basis, decomposes each flow realization into large scale and small scale flows, in a way similar to large eddy simulation(LES) filtering. It is shown that the large scale flow thus obtained does not extract the vortex tubes equally well as the coherent flow resulting from the CVS decomposition. Moreover, the small scale flow still contains coherent structures, and its velocity PDF is stretched exponential, while the incoherent flow is structureless, decorrelated, and its velocity PDF is Gaussian. Thus, modeling the effect of the incoherent flow discarded by CVS-wavelet shall be easier than modeling the effect of the small scale flow discarded by POD-Fourier or LES.

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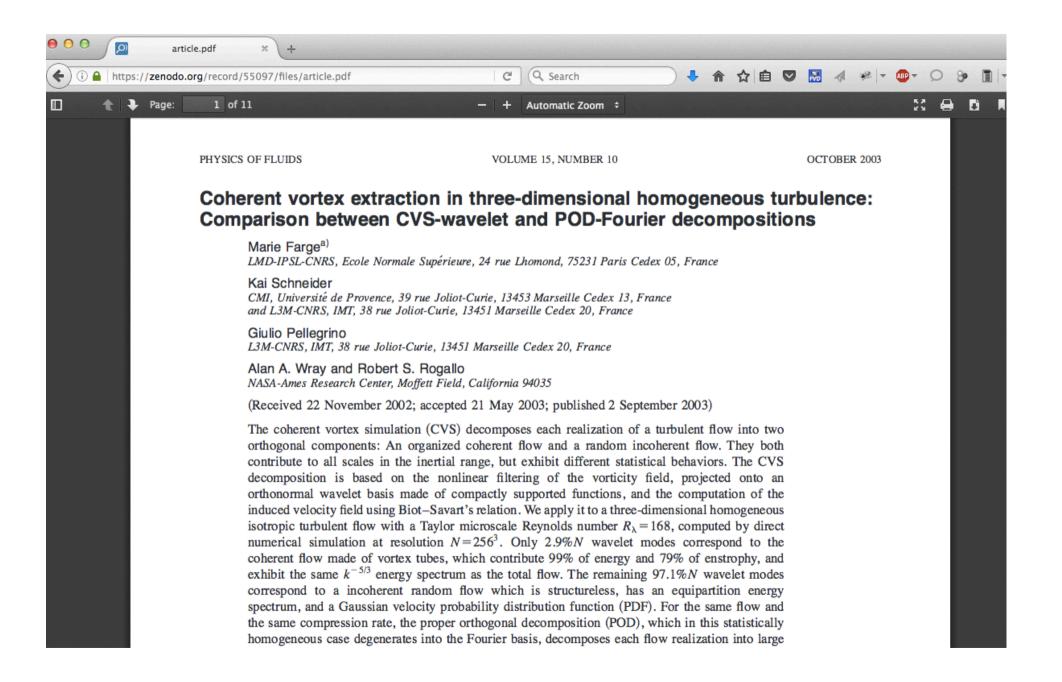
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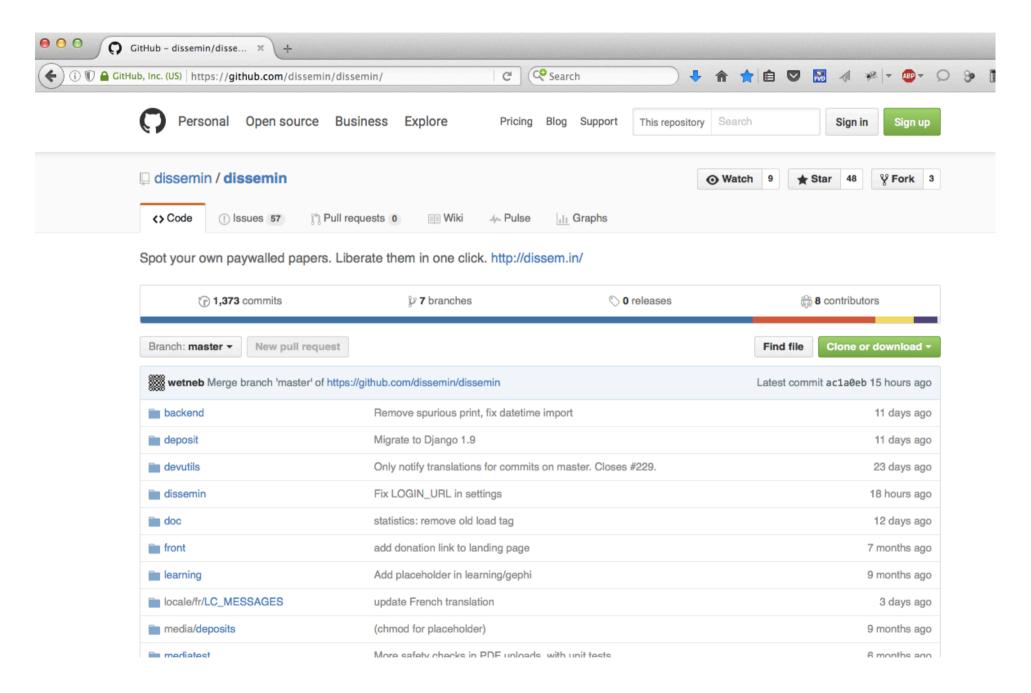
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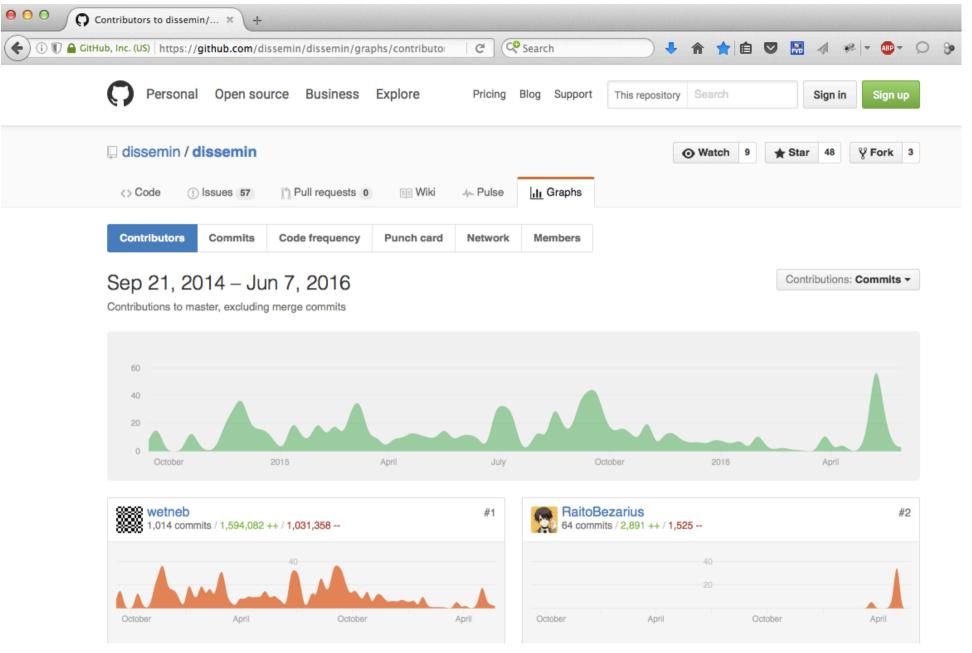
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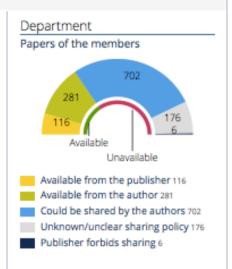
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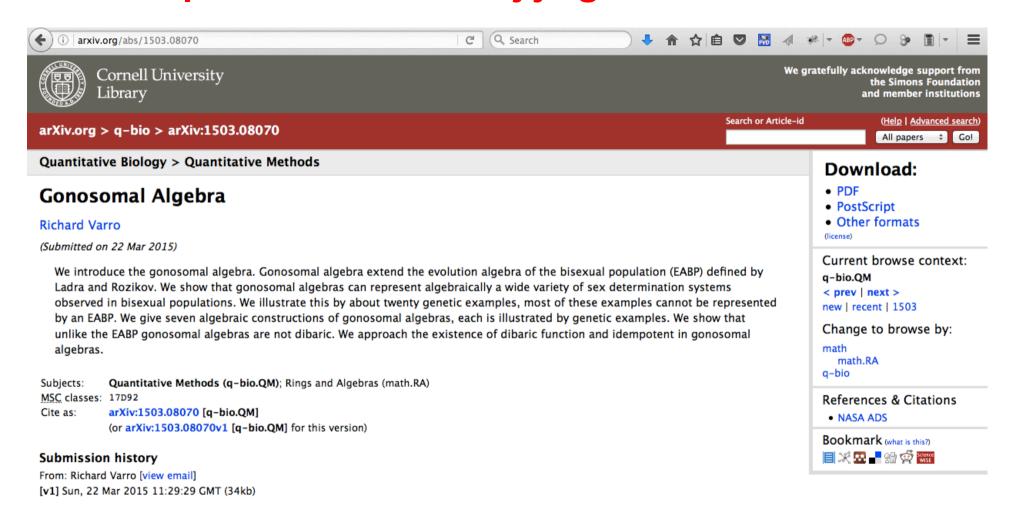
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Charlotte Hess and Elinor Ostrom, Understanding knowledge as a Commons, MIT Press, 2006

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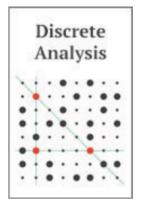
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# Two diamond open access journals



IPOL Journal · Image Processing On Line

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Founded in 2015 by Tim Gowers, it has 12 editors. It is an overlay journal on the open repository arXiv. It is financed by Cambridge University (10\$/submission).

# We need publishing platforms

1

Funding agencies should provide to the scientific community publicly-owned platforms, developed in open source software, for editing, publishing and archiving peer-reviewed articles, with the help of librarians, and publishers as contractors.

2

Funding agencies could thus control the quality of peer-reviewing, by selecting the journals having good practices and reputable editors.

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# Green open access is a wise model

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Vincent Larivière et al., The Oligopoly of Academic Publishers, PLOS one, 10th June 2015

The gold open access model leads to the creation of predatory journals of very poor quality, even fake journals. To avoid this and to guarantee a smooth transition to open access, researchers would like to preserve the main traditional journals which are useful, having a good reputation and good practices.



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