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New insights into spatial characterization of turbulent flows: a complex network-based analysis

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New insights into spatial characterization of turbulent flows: a complex network-based analysis / Iacobello, Giovanni; Scarsoglio, Stefania; Ridolfi, Luca. - ELETTRONICO. - 8(2016), pp. 38-38. ((Intervento presentato al convegno 8th European Postgraduate Fluid Dynamics tenutosi a Warsaw, Poland nel July, 6-9, 2016.

*Availability:*

This version is available at: 11583/2645299 since: 2017-10-03T18:23:35Z

*Publisher:*

European Mechanics Society

*Published*

DOI:

*Terms of use:*

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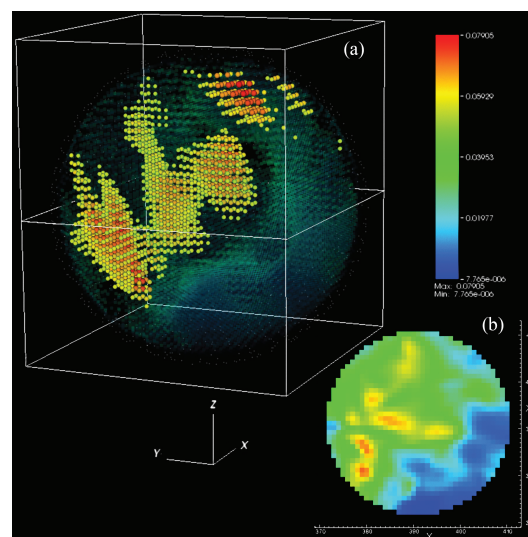
**ABSTRACT 25: NEW INSIGHTS INTO SPATIAL CHARACTERIZATION OF TURBULENT FLOWS: A COMPLEX NETWORK-BASED ANALYSIS**

**Giovanni Iacobello<sup>1</sup>, Stefania Scarsoglio<sup>1</sup>, Luca Ridolfi<sup>2</sup>**

1 Polytechnic University of Turin - Department of Mechanical and Aerospace Engineering

2 Polytechnic University of Turin - Department of Environmental, Land and Infrastructure Engineering

Despite much progress has been made, several mechanisms about turbulence dynamics are still unclear. We propose an innovative approach based on complex networks theory, which combines elements from graph theory and statistical physics, providing a powerful framework to investigate complex systems. The network is built on a forced isotropic turbulent field, by evaluating the temporal correlation of the kinetic energy for pairs of nodes within the Taylor microscale,  $\lambda$ . Among all the parameters analyzed, the degree centrality,  $k$ , is one of the most meaningful, representing how a node is linked to the others. We observe 3D patterns of high  $k$  values, which can be interpreted as regions of spatial coherence. The turbulent network exhibits typical behaviors of real and spatial networks (scale-free property). Similarly to other physical systems where complex networks successfully apply, our approach can give new insights for the spatial characterization of turbulence.



**Figure:** Network built from the JHTDB (<http://turbulence.pha.jhu.edu>) considering a sphere of radius  $\lambda$ , centered in the node  $C(391,391,512)$ . (a) Degree centrality on a 3D view; (b) Degree centrality on a section normal to  $Z$ -axis and passing through  $C$ .