

AN INTERACTIVE TOPOLOGICAL ORGANIZATION OF A VORTEX BETWEEN VORTICAL FLOW AND BUNDLE OF VORTICITY LINES

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ABSTRACT

The present study clarifies a mechanism of an interactive organization of vortical flow structure and bundle of vorticity lines of a vortex. The formulation of the vortex stretching in a Galilei invariant coordinate system associated with the swirl plane, vortex space [1], shows that the vortical flow structure swirls a bundle of the vorticity lines which feature depends on the topological dynamics of the flow along a vortical region. Inversely, the velocity structure is influenced by swirling or rotating feature of the vorticity lines, which generates the axial flow of the vortex. The local axis geometry scheme specifies the topology of the bundle in the vortical region, and the topological quantities, i.e., swirlity, sourcity, and vortical flow symmetry [2], clarify the topological characteristics of both vortical flow and vorticity lines. This theory conjectures the specific vortical structure in a homogeneous isotropic turbulence or wind turbine.

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- [1] Nakayama, K. 2017 Topological features and properties associated with development/decay of vortices in isotropic homogeneous turbulence. *Phy. Rev. Fluids* **2**, 014701.
- [2] Nakayama, K. 2014 Physical properties corresponding to vortical flow geometry. *Fluid Dyn. Res.* **46**, 055502.