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Decomposition of Fluid Acceleration by Rotational and Irrotational Motion in Isotropic Turbulence YONGNAM PARK, CHANGHOON LEE, Yonsei University — It is well known that fluid acceleration in turbulence is highly intermittent. Source of the intermittency was found to be closely related to the rotational motion of coherent vortical structures. From the Poisson equation for pressure, $\frac{1}{\rho}\nabla^2 P = \Omega - \frac{\epsilon}{2\nu}$, acceleration, which is mostly the negative of pressure gradient, can be expressed as a sum of acceleration-like terms, $-\nabla(\nabla^2)^{-1}\Omega + \nabla(\nabla^2)^{-1}\frac{\epsilon}{2\nu}$, each of which is named as a^Ω and a^ϵ . They are acceleration due to rotational motion of eddy and acceleration due to irrotational strain field, respectively. We investigated the statistical characteristics of those accelerations by using direct numerical simulation of isotropic turbulence. Flatness of acceleration is of order of 10 but flatness of a^Ω and a^ϵ are $3 \sim 5$ which represents less intermittency in the range of $Re_\lambda = 47 \sim 130$. Based on the cylinder vortex model, we show that probability density function of acceleration must have -5/3 slope and pdf's of a^Ω and a^ϵ must have -3 slope in log- log scale when the Reynolds number is infinite. Numerical and experimental results do not show clear slope since the Reynolds number is relatively low, but an asymptotic behavior is observed.

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