Particle pair rotation to constrain the non-uniqueness problem in Lagrangian stochastic modelling of turbulent relative dispersion

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It is well known that a non-uniqueness problem arises in Lagrangian modelling with the Well-Mixed approach. This indetermination is a relevant problem because model solutions differ strongly. In order to constrain the non-uniqueness problem, the idea of a fluid particle pair as a couple of material points rotating around their centre of mass is proposed to model turbulent relative dispersion in the inertial range. The properties of the stochastic process derived are analysed with respect to the following turbulent velocity characteristics: i) compatibility with the Navier-Stokes equations ii) compatibility with the vorticity field iii) preservation of isotropy iv) correct behaviour in the small-lengthscale limit and large fluctuations regime. A Markov model is developed in stationary homogeneous isotropic turbulence. A consistent comparison of the particle separation statistics with direct numerical simulation data is observed in the inertial range, supporting the formulation proposed.