Flow Field Expression with Superposition of Dipole KAZUYUKI
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Engineering, Tohoku University — Classical dipole in fluid mechanics has a singular
point and the flow field around it is irrotational. In this study, extended dipole with
rotational core region is introduced. It is a compact vortex pair in two-dimensional
flow or a compact vortex ring in three-dimensional flow without singular points.
Dipole moment of the extended dipole is related to rotation of vorticity, namely,
Laplacian of velocity field. This relation gives general expression of induced velocity
described with dipole moment and a compact kernel function of the core. This
induced velocity has no singularity, automatically satisfies divergence-free condition
for incompressible fluid, and is equal to classical dipole flow in far filed. Expression
of an arbitrary flow field with superposition of the extended dipole is proposed. In
case of continuous distribution of dipole moment, it results in a convolution integral.
This convolution is discussed in association with the continuous wavelet transform.

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