On Axisymmetry of Vortex Rings AHMAD FALAHATPISHEH,
ARASH KHERADVAR, Univ of California - Irvine — The shape of vortex rings
can be an indication of the axisymmetry of propulsion or transient jet flows. There
are many conditions that vortex rings deviate from axisymmetry. For the first time,
we introduce a metric, called axisymmetry index, ξ, that measures the axisymmetry
of vortex rings with a single value. Axisymmetry index examines the spectrum of
the impulse of the ring in azimuthal planes and reports the degree by which the ring
deviates from axisymmetry. The index is systematically investigated in analytical
and numerical cases. A perfect axisymmetric ring is associated with $\xi = 1$. It is
validated in Gaussian vortex ring and Hill's spherical vortex, where the computed
indices are found to be in agreement with $\xi = 1$. A family of non-axisymmetric
vortex rings are parametrically generated to study the relation of the index with the
ratio of the maximum of circulation to the minimum of circulation of the ring. The
results show that as the second moment of vorticity on one side increases compared
to the other side, the deviation of the ring from axisymmetry increases, hence, a de-
crease in the index from unity. We also present results of numerically investigating
the axisymmetry of a non-axisymmetric vortex ring that forms downstream of an
oval-shaped nozzle.

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