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A Levitating/Rotating Ball: C.V, Euler n Equation and Topology Demonstrator JOHN FOSS, RICARDO MEJIA-ALVAREZ, JAMES GEDDES, Michigan State University — An axisymmetric jet, oriented near 45^o of $-\mathbf{g}$, can levitate and rotate a ball (Shapiro, 1968). This phenomenon provides a learning experience for control volume, Euler n and topology analyses. Using J_1 as the momentum flux vector at the jet exit, a C.V. surrounding the ball (weight $\mathbf{W}$) and extending beyond it reveals: $J_2 = \mathbf{i}\, J_1\} x + \mathbf{j}\,(\, J_1\} y - \mathbf{W})$. The moment-of-momentum Eq., summed about the c.g. of the ball, establishes the normal distance (δ_2) from the balls c.g. to the line of action of J_2: $\delta_2 = \delta_1\,[J_1/J_2]$. The no-slip condition shows that the jet fluid does not touch the ball. Topologically, the required two nodes of the overlaid vector field are present at the lateral sides of the ball. From Foss (2004) the fore and aft saddles plus the underneath node satisfy the Topological Constraint and reveal a unique wake structure. Surface pressures make rational the force balance.

A.H. Shapiro, (1968). Pressure fields and fluid acceleration. NCFMF, http://web.mit.edu/hml/ncfmf.html
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