Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Application of Kelvin's Inversion Theorem in mesh based numerical simulation of flows in unbounded domains JOHN RUSSELL, Professor Emeritus, Florida Institute of Technology — One may decompose an unbounded domain exterior to a solid body into two parts separated by a sphere of radius a, which I will call the *Reflecting Sphere*. The *Near Exterior* is exterior to the solid body but interior to the Reflecting Sphere while the *Far Exterior* is exterior to both. Suppose the velocity field in the Far Exterior has a velocity potential, ϕ. In the 1840s KELVIN showed that the change of position variable $\mathbf{r} \to \mathbf{q}$ defined by $\mathbf{r}/r = \mathbf{q}/q$ and $rq = a^2$ (in which $r = |\mathbf{r}|$ and $q = |\mathbf{q}|$) maps the Far Exterior to an *Inverted Far Exterior* (the interior of the Reflecting Sphere). Furthermore, if $\mathbf{r} \mapsto \phi$ is a solution of LAPLACE's equation in the $\mathbf{r}$-coordinates then $\mathbf{q} \mapsto \Phi$, in which $\phi = (q/a)\Phi$, is a solution of LAPLACE's equation in the $\mathbf{q}$-coordinates. Boundedness of both the Near Exterior and Inverted Far Exterior enables simultaneous solution of the relevant partial differential equations provided one applies suitable compatibility conditions on the Reflecting Sphere. The talk will present simulations of this kind along with comparisons with analytical solutions.

John Russell
Professor Emeritus, Florida Institute of Technology

Date submitted: 01 Aug 2013 Electronic form version 1.4