1. Find the Jacobian for hyperbolic coordinates. The position vector is given by

\[ \vec{R}(u, v) = \left( \frac{u^2 - v^2}{2}, uv \right) \]

a. Find the coordinate tangent vectors:

\[ \vec{e}_u = \frac{\partial \vec{R}}{\partial u} = \]

\[ \vec{e}_v = \frac{\partial \vec{R}}{\partial v} = \]

b. Compute the Jacobian determinant:

\[ \frac{\partial(x, y)}{\partial(u, v)} = \]

c. Compute the Jacobian factor:

\[ J = \left| \frac{\partial(x, y)}{\partial(u, v)} \right| = \]
2. Find the Jacobian for spherical coordinates. The position vector is given by

\[ \vec{R}(\rho, \theta, \varphi) = (\rho \sin \varphi \cos \theta, \rho \sin \varphi \sin \theta, \rho \cos \varphi) \]

a. Find the coordinate tangent vectors:

\[ \vec{e}_\rho = \frac{\partial \vec{R}}{\partial \rho} = \]

\[ \vec{e}_\theta = \frac{\partial \vec{R}}{\partial \theta} = \]

\[ \vec{e}_\varphi = \frac{\partial \vec{R}}{\partial \varphi} = \]

b. Compute the Jacobian determinant:

\[ \frac{\partial (x, y, z)}{\partial (\rho, \theta, \varphi)} = \]

c. Compute the Jacobian factor:

\[ J = \left| \frac{\partial (x, y, z)}{\partial (\rho, \theta, \varphi)} \right| = \]