

Simple Sample

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<i>Cartesian</i>	<i>Spherical</i>
$x(r, \varphi, \theta) =$	$r(x, y, z) =$
$y(r, \varphi, \theta) =$	$\varphi(x, y, z) =$
$z(r, \varphi, \theta) =$	$\theta(x, y, z) =$

basis

$$\mathbf{r} = x\hat{x} + y\hat{y} + z\hat{z} = x(r, \varphi, \theta) \hat{x} + y(r, \varphi, \theta) \hat{y} + z(r, \varphi, \theta) \hat{z}$$

$\frac{\partial \vec{r}}{\partial x} = \vec{x} =$	$\frac{\partial \vec{r}}{\partial r} = \vec{r} =$
$\frac{\partial \vec{r}}{\partial y} = \vec{y} =$	$\frac{\partial \vec{r}}{\partial \varphi} = \vec{\varphi} =$
$\frac{\partial \vec{r}}{\partial z} = \vec{z} =$	$\frac{\partial \vec{r}}{\partial \theta} = \vec{\theta} =$

$$\mathbf{r} = r(x, y, z) \vec{r} + \varphi(x, y, z) \vec{\varphi} + \theta(x, y, z) \vec{\theta} = r\vec{r} + \varphi\vec{\varphi} + \theta\vec{\theta}$$

$\frac{\partial \vec{r}}{\partial x} = \vec{x} =$	$\frac{\partial \vec{r}}{\partial r} = \vec{r} =$
$\frac{\partial \vec{r}}{\partial y} = \vec{y} =$	$\frac{\partial \vec{r}}{\partial \varphi} = \vec{\varphi} =$
$\frac{\partial \vec{r}}{\partial z} = \vec{z} =$	$\frac{\partial \vec{r}}{\partial \theta} = \vec{\theta} =$

Notice:

$$\frac{\partial \mathbf{r}}{\partial r} = \vec{r} = \partial_r x \hat{x} + \partial_r y \hat{y} + \partial_r z \hat{z}$$

$$J_{xyz \rightarrow r\varphi\theta} = \frac{\partial(x,y,z)}{\partial(r,\varphi,\theta)} = \begin{bmatrix} \partial_r x & \partial_\varphi x & \partial_\theta x \\ \partial_r y & \partial_\varphi y & \partial_\theta y \\ \partial_r z & \partial_\varphi z & \partial_\theta z \end{bmatrix}$$

\vec{r}	$\vec{\varphi}$	$\vec{\theta}$
$\partial_r x$	$\partial_\varphi x$	$\partial_\theta x$
$\partial_r y$	$\partial_\varphi y$	$\partial_\theta y$
$\partial_r z$	$\partial_\varphi z$	$\partial_\theta z$