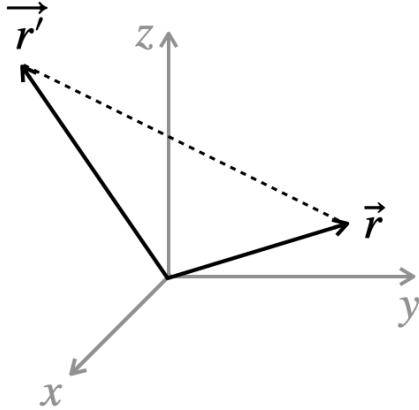


1 Distance Formula in Curvilinear Coordinates

The distance $|\vec{r} - \vec{r}'|$ between the point $\vec{r}$ and the point $\vec{r}'$ is a coordinate-independent, physical and geometric quantity. But, in practice, you will need to know how to express this quantity in different coordinate systems.

- (a) Find the distance $|\vec{r} - \vec{r}'|$ between the point $\vec{r}$ and the point $\vec{r}'$ in rectangular coordinates.



- (b) Show that this same distance written in cylindrical coordinates is:

$$|\vec{r} - \vec{r}'| = \sqrt{s^2 + s'^2 - 2ss' \cos(\phi - \phi') + (z - z')^2}$$

Hint: You may want to use the textbook: GMM: Change of Coordinates

- (c) Show that this same distance written in spherical coordinates is:

$$|\vec{r} - \vec{r}'| = \sqrt{r'^2 + r^2 - 2rr' [\sin \theta \sin \theta' \cos(\phi - \phi') + \cos \theta \cos \theta']}$$

Hint: You may want to use the textbook: GMM: Change of Coordinates

- (d) Now assume that $\vec{r}'$ and $\vec{r}$ are in the x - y plane. Simplify the previous two formulas.