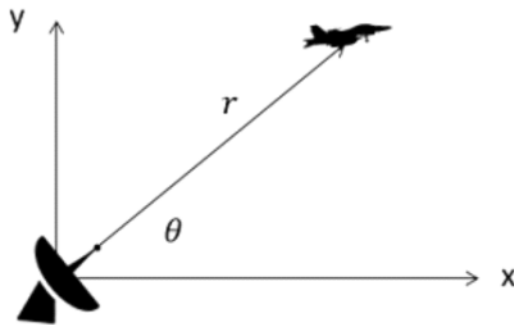# Question 1:

A radar tracking station gives the following raw data to a user at a given point in time. Based on this data, what is the current velocity and acceleration in the r and theta directions? What is the current velocity and acceleration in the x and y directions?

$$\theta = 40°$$
$$\dot{\theta} = -.039 \text{ rad/s}$$
$$\ddot{\theta} = .003807 \text{ rad/s}^2$$

$$r = 6400 \text{ ft}$$
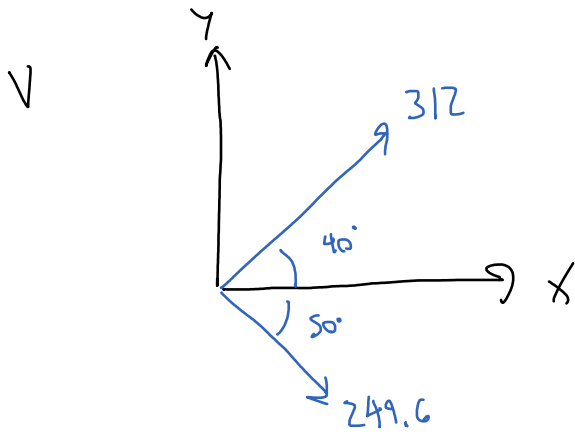$$\dot{r} = 312 \text{ ft/s}$$
$$\ddot{r} = 9.751 \text{ ft/s}^2$$

$$V = \dot{r}\,\hat{U}_r + r\dot{\theta}\,\hat{U}_\theta = 312\,\hat{U}_r + (6400)(-.039)\,\hat{U}_\theta$$

$$V_r = 312 \text{ ft/s}$$
$$V_\theta = -249.6 \text{ ft/s}$$

$$a = \left(\ddot{r} - r\dot{\theta}^2\right)\hat{U}_r + \left(r\ddot{\theta} + 2\dot{r}\dot{\theta}\right)\hat{U}_\theta =$$

$$\left((9.751) - (6400)(-.039)^2\right)\hat{U}_r + \left((.003807)(6400) + (2)(312)(-.039)\right)\hat{U}_\theta$$

$$a_r = .0166 \text{ ft/s}^2$$

$$a_\theta = .0288 \text{ ft/s}^2$$

V

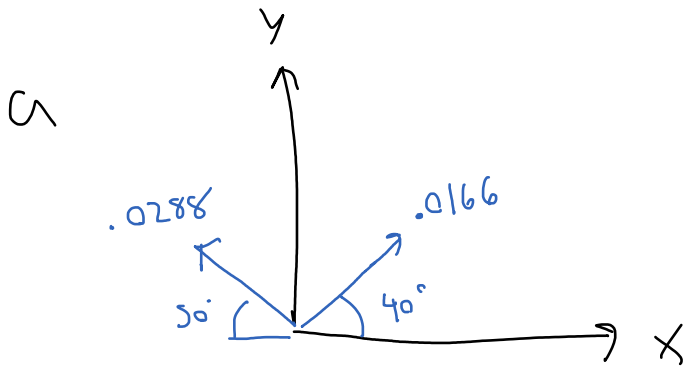$V_x = 312 \cos(40) + 249.6 \cos(50)$

$$\boxed{V_x = 399.4 \text{ ft/s}}$$

$V_y = 312 \sin(40) - 249.6 \sin(50)$

$$\boxed{V_y = 9.35 \text{ ft/s}}$$

G

$a_x = .0166 \cos(40) - .0288 \cos(50)$

$$\boxed{a_x = -.0058 \text{ ft/s}^2}$$

$a_y = .0166 \sin(40) + .0288 \sin(50)$

$$\boxed{a_y = .0327 \text{ ft/s}^2}$$