2. Circular Trajectories

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Lecture due Oct 5, 2021 20:30 IST

Practice

Circle 1

1/1 point (graded)

In lecture, we saw the parametric equations for the unit circle. More generally, one may consider the equations

$$x(t) = a + r\cos t \quad (6.95)$$
$$y(t) = b + r\sin t \quad (6.96)$$
$$\text{where} \quad 0 \le t < 2\pi \quad (6.97)$$

What is the resulting trajectory?

- (selected) A circle centered at (a, b) with radius r.
- A circle centered at (a, b) with radius r^2.
- A circle centered at (b, a) with radius r.
- A circle centered at $(0, 0)$ with radius $a + b + r$.
- None of the above

✔

Solution:

The new radius is r, because the trajectory will be the unit circle scaled by r. The a and b terms serve to translate the x coordinate by a units to the right, and the y coordinate by b units up. The the correct choice is "A circle centered at (a, b) with radius r.".

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Answers are displayed within the problem

Circle 2

1/1 point (graded)

Now consider the equations:

$$x(t) = \sin t \quad (6.98)$$
$$y(t) = \cos t \quad (6.99)$$
$$\text{where} \quad 0 \le t < \pi \quad (6.100)$$

What is the resulting trajectory?

- A semi-circle contained in the $x \le 0$ half-plane.
- (selected) A semi-circle contained in the $x \ge 0$ half-plane.

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- A semi-circle contained in the $y \geq 0$ half-plane.
- A semi-circle contained in the $y \leq 0$ half-plane.
- None of the above

✔

Solution:

We still have $x^2 + y^2 = 1$, so the trajectory is contained in a unit circle. By plotting points, we can see that x will move from 0, up to 1, then back to 0. Simliarly, we find that y moves from 1 to -1. Therefore, the correct choice is the semi-circle in the $x \geq 0$ half-plane.

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Circular Parametric

1/1 point (graded)

Consider the unit circle given by $x^2 + y^2 = 1$. Which of the following parametric equations describes this curve for $t > 0$?

$$\vec{r}_1 = \begin{pmatrix} \cos t \\ \sin t \end{pmatrix}, \quad \vec{r}_2 = \begin{pmatrix} \cos(-t) \\ \sin(-t) \end{pmatrix} \tag{6.101}$$

$$\vec{r}_3 = \begin{pmatrix} \sin t \\ \cos t \end{pmatrix}, \quad \vec{r}_4 = \begin{pmatrix} t \\ \sqrt{1-t^2} \end{pmatrix} \tag{6.102}$$

- [x] $\vec{r}_1$
- [x] $\vec{r}_2$
- [x] $\vec{r}_3$
- [ ] $\vec{r}_4$

✔

Solution:

Although $\vec{r}_1$, $\vec{r}_2$ and $\vec{r}_3$ have generally different motions, they all eventually trace out the unit circle trajectory.

The $\vec{r}_4$ option could only trace out the top half of the circle, and for $t > 0$ we only get a quarter of the circle. Furthermore, the domain of $\vec{r}_4$ is restricted to $t < 1$.

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