1 Circle and Points

The system involves a circle of radius $r = 30$, with points placed at four specific angles. These points are calculated using the parametric equations for the circle.

Given the radius r, the points on the circle are defined by the following parametric equations:

$$x(t) = r\cos(\theta), \quad y(t) = r\sin(\theta)$$

where θ is the angle at which the point is located. For this example, the points are calculated at the following angles:

$$\theta_1 = 45^\circ, \quad \theta_2 = 135^\circ, \quad \theta_3 = 225^\circ, \quad \theta_4 = 315^\circ$$

The coordinates of these points are:

$$\text{Point 1: } (r\cos(45^\circ), r\sin(45^\circ)) = (15\sqrt{2}, 15\sqrt{2})$$

$$\text{Point 2: } (r\cos(135^\circ), r\sin(135^\circ)) = (-15\sqrt{2}, 15\sqrt{2})$$

$$\text{Point 3: } (r\cos(225^\circ), r\sin(225^\circ)) = (-15\sqrt{2}, -15\sqrt{2})$$

$$\text{Point 4: } (r\cos(315^\circ), r\sin(315^\circ)) = (15\sqrt{2}, -15\sqrt{2})$$

2 Tangent Lines

The tangent line to a circle at any point is perpendicular to the radius at that point. The slope of the radius is given by:

$$\text{slope of radius} = \frac{y(t)}{x(t)}$$

For the tangent line, the slope is the negative reciprocal of the slope of the radius. Therefore, the slope of the tangent line at any point $(x(t), y(t))$ is:

$$\text{slope of tangent} = -\frac{x(t)}{y(t)}$$

Tangent Line at Point 1: $(15\sqrt{2}, 15\sqrt{2})$ The slope of the tangent line at this point is:

$$\text{slope} = -\frac{15\sqrt{2}}{15\sqrt{2}} = -1$$

Thus, the equation of the tangent line at this point is:

$$y - 15\sqrt{2} = -1(x - 15\sqrt{2})$$

which simplifies to:

$$y = -x + 30\sqrt{2}$$

Tangent Line at Point 2: $(-15\sqrt{2}, 15\sqrt{2})$ The slope of the tangent line at this point is:

$$\text{slope} = -\frac{-15\sqrt{2}}{15\sqrt{2}} = 1$$

Thus, the equation of the tangent line at this point is:

$$y - 15\sqrt{2} = 1(x + 15\sqrt{2})$$

which simplifies to:

$$y = x + 30\sqrt{2}$$

Tangent Line at Point 3: $(-15\sqrt{2}, -15\sqrt{2})$ The slope of the tangent line at this point is:

$$\text{slope} = -\frac{-15\sqrt{2}}{-15\sqrt{2}} = 1$$

Thus, the equation of the tangent line at this point is:

$$y + 15\sqrt{2} = 1(x + 15\sqrt{2})$$

which simplifies to:

$$y = x - 30\sqrt{2}$$

Tangent Line at Point 4: $(15\sqrt{2}, -15\sqrt{2})$ The slope of the tangent line at this point is:

$$\text{slope} = -\frac{15\sqrt{2}}{-15\sqrt{2}} = -1$$

Thus, the equation of the tangent line at this point is:

$$y + 15\sqrt{2} = -1(x - 15\sqrt{2})$$

which simplifies to:

$$y = -x - 30\sqrt{2}$$

3 Conclusion

The tangent lines at the four points on the circle with radius $r = 30$ are given by the following equations:

$$\text{Tangent at } (15\sqrt{2}, 15\sqrt{2}) : \quad y = -x + 30\sqrt{2}$$
$$\text{Tangent at } (-15\sqrt{2}, 15\sqrt{2}) : \quad y = x + 30\sqrt{2}$$
$$\text{Tangent at } (-15\sqrt{2}, -15\sqrt{2}) : \quad y = x - 30\sqrt{2}$$
$$\text{Tangent at } (15\sqrt{2}, -15\sqrt{2}) : \quad y = -x - 30\sqrt{2}$$

These tangent lines are placed at the calculated points in the OpenSCAD model to visualize the geometry of the circle and its tangents.