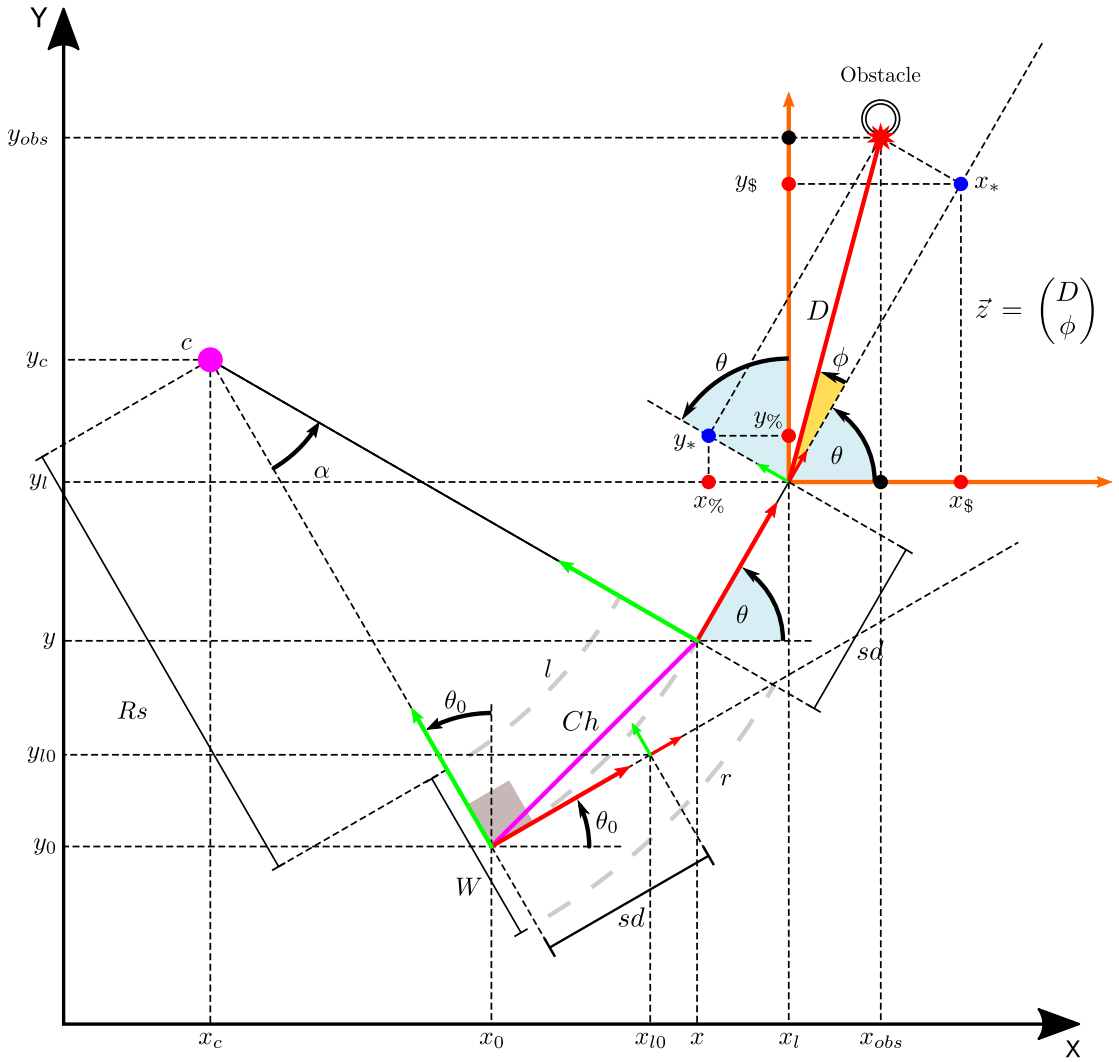
Obstacle's coordinates in the global reference frame



$$
\begin{aligned}
r &= (Rs + W)\,\alpha \\
l &= Rs\,\alpha \\
r - l &= W\,\alpha
\end{aligned}
$$

$$
\begin{aligned}
\alpha &= \frac{r - l}{W} \\
Rs &= \frac{l}{\alpha}
\end{aligned}
$$

$$
\begin{aligned}
x_l &= x + sd\cos(\theta) \\
y_l &= y + sd\sin(\theta)
\end{aligned}
$$

$$
\begin{aligned}
\cos(u \pm v) &= \cos u\cos v \mp \sin u\sin v \\
\sin(u \pm v) &= \sin u\cos v \pm \cos u\sin v
\end{aligned}
$$

$$
\begin{aligned}
\cos\left(\theta + 90^\circ\right) &= -\sin(\theta) \\
\sin\left(\theta + 90^\circ\right) &= +\cos(\theta)
\end{aligned}
$$

$$
\begin{aligned}
x_{obs} &= x_l + x_\$ + x_\% \\
&= x + sd\cos(\theta) + x_*\cos(\theta) + y_*\cos\left(\theta + 90^\circ\right) \\
&= x + sd\cos(\theta) + D\cos(\phi)\cos(\theta) + D\sin(\phi)\cos\left(\theta + 90^\circ\right) \\
&= x + sd\cos(\theta) + D\cos(\phi)\cos(\theta) - D\sin(\phi)\sin(\theta) \\
&= x + sd\cos(\theta) + D\cos(\theta + \phi)
\end{aligned}
$$

$$
\begin{aligned}
y_{obs} &= y_l + y_\$ + y_\% \\
&= y + sd\sin(\theta) + x_*\sin(\theta) + y_*\sin\left(\theta + 90^\circ\right) \\
&= y + sd\sin(\theta) + D\cos(\phi)\sin(\theta) + D\sin(\phi)\sin\left(\theta + 90^\circ\right) \\
&= y + sd\sin(\theta) + D\cos(\phi)\sin(\theta) + D\sin(\phi)\cos(\theta) \\
&= y + sd\sin(\theta) + D\sin(\theta + \phi)
\end{aligned}
$$