BE 2. Dynamic localization with contractors

Download the QT project `http://www.ensta-bretagne.fr/jaulin/mer_sivia_vibes`, compile it and run it. Install VIBES first.

1) A robot located at (x, y) is able to measure its distance to $n = 3$ landmarks. The landmark positions and the corresponding distances are reported below:

x_i	3	7	-3
y_i	4	3	7
d_i	3	6	6

The errors on the distances in ± 0.5. Using a set inversion algorithm with contractors, find all feasible locations for the robot.

2) The robot is now moving. It satisfies the following discrete time state equations

$$
\begin{aligned}
x_{k+1} &= x_k + dt.(\cos \theta_k + n_k^1) \\
y_{k+1} &= y_k + dt.(\sin \theta_k + n_k^2) \\
\theta_{k+1} &= \theta_k + dt.\left(u_k + n_k^3\right)
\end{aligned}
$$

The state noise n_k^i is a random number inside $[-0.1, 0.1]$. The robot measures (i) its heading θ_k with an accuracy of 0.1rad and the distance to each landmark with an accuracy of $\pm 1m$. Program a simulation of the robot so that it performs approximately a eight figure among the landmarks.

3) Propose a instantaneous localization (using the collected distances only).

4) Propose a dynamic localization of the robot.

5) Remove the compass and adapt your localization method.