Introduction to robotics for hydrographers

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Moqesm Brest, Oct 11, 2016
What is a robot?

Why do we need robots?

Security

Introduction to robotics for hydrographers
A robot is a mechanical system equipped with actuators, sensors and a brain.
What is a robot?
Why do we need robots?
Security

Saucisse (ENSTA Bretagne)
What is a robot?
Why do we need robots?
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Vaimos at the WRSC (ENSTA Bretagne-IFREMER)
F. Le Bars, O. Ménage, P. Rousseau (Vaimos in Angers)
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A robot is a dynamical system
A dynamical system can be written as \([\text{Newton 1690}]\)

\[
\dot{x} = f(x).
\]
Example: The pendulum

\[
\begin{cases}
\dot{x}_1 = x_2 \\
\dot{x}_2 = -\sin x_1.
\end{cases}
\]
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A robot is a vehicle
A vehicle is a controlled mechanical system

\[ \dot{x} = f(x, u). \]
Example. Dubin’s car (1957).

\[
\begin{align*}
\dot{x} &= \cos \theta \\
\dot{y} &= \sin \theta \\
\dot{\theta} &= u
\end{align*}
\]

with \( u \in [-1, 1] \).
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Dubin’s paths
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Simulation (Euler, 1770)

\[
\dot{x} = f(x, u) \sim x(t + dt) = x(t) + dt \cdot f(x(t), u(t))
\]
A robot is an intelligent vehicle
A robot is a vehicle with actuators, sensors, and a brain

\[ \dot{x} = f(x, u) \quad (\text{évolution}) \]
\[ y = g(x) \quad (\text{observation}) \]
\[ u = h(y). \quad (\text{contrôle}) \]

We have

\[ \dot{x} = f(x, h(g(x))) = \psi(x) \]

and thus a robot is a dynamical system.
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Brest-Douarnenez. January 17, 2012
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Ocean satellites?
What is a robot?
Why do we need robots?
Security

Robots are needed for dirty, dangerous and dull jobs
What is a robot?  
Why do we need robots?  
Security  
Curiosity  

Curiosity
About 3,600 satellites in orbit (1,000 are operational). In the ocean, we have gliders, drifting buoys. In the ocean, a robot could be autonomous in energy, and could survive for years (persistent autonomy).
Montrer Vaimos dans l’océan Atlantique.
An example (with CGG)
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A robot $\dot{x} = f(x)$.

**Example:** The Van der Pol system

\[
\begin{aligned}
\dot{x}_1 &= x_2 \\
\dot{x}_2 &= (1 - x_1^2) \cdot x_2 - x_1
\end{aligned}
\]
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Reachable set
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Middle of Atlantique ocean, 350 km made by Vaimos, sept. 6-9, 2012.