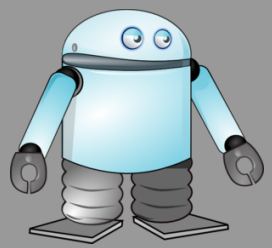
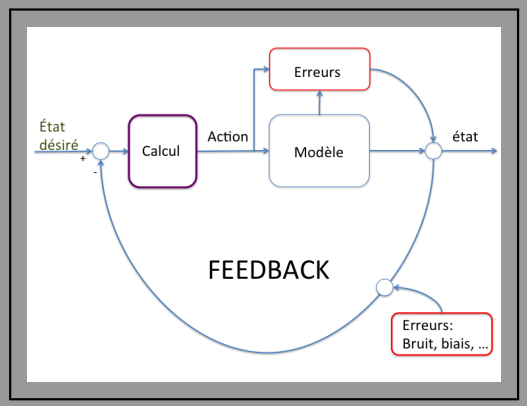
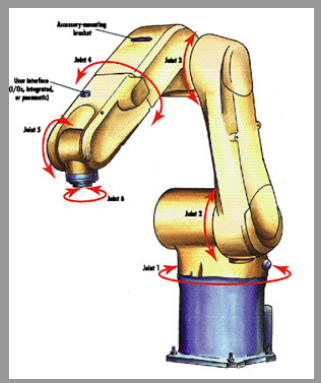
de l'Automatique à la Robotique . . .

Mazen Alamir

GIPSA-lab, département automatique, CNRS







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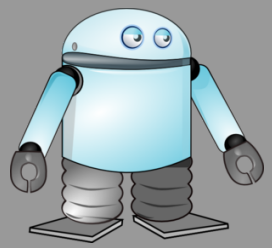
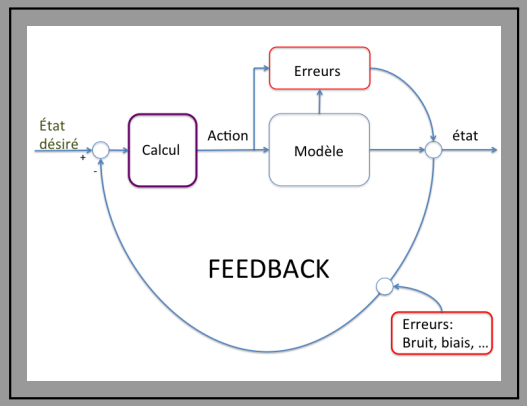
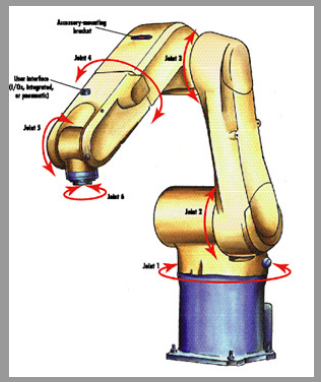


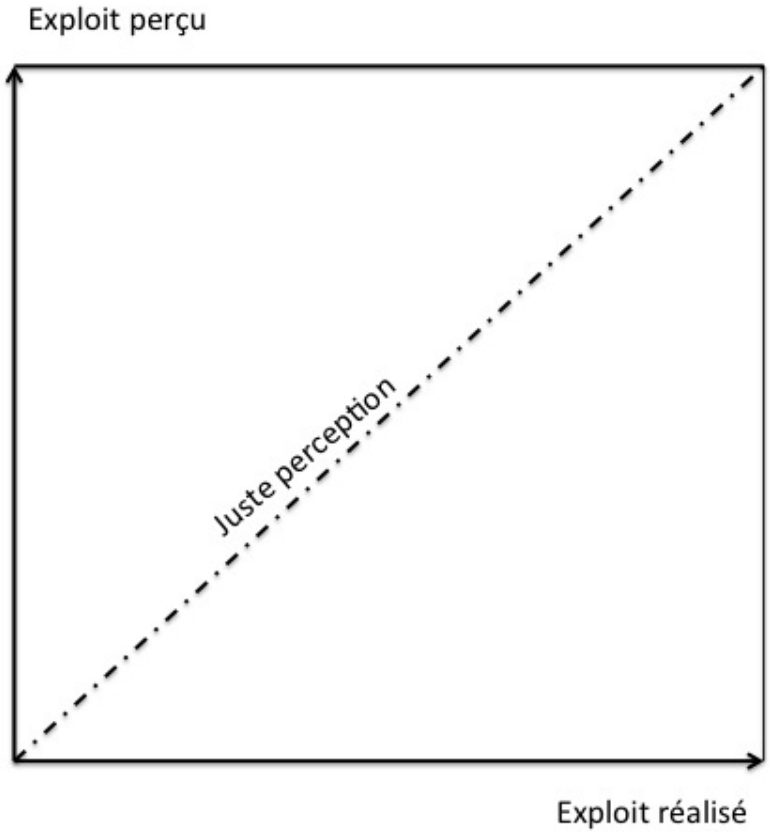




La robotique est plus *sexy* que l'automatique

La robotique est plus visible que l'automatique

Une bataille perdue



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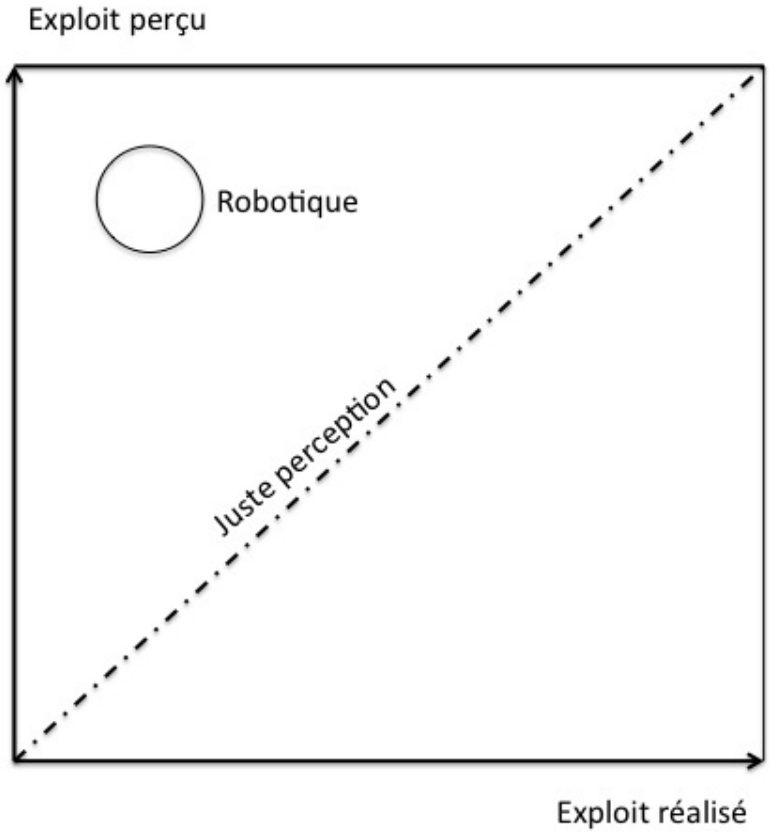

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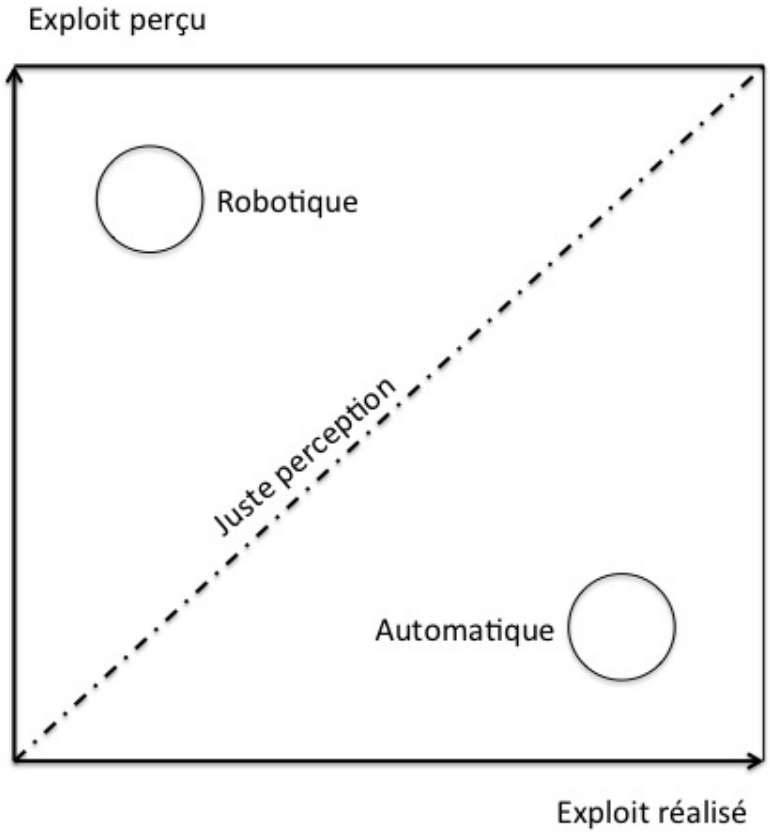

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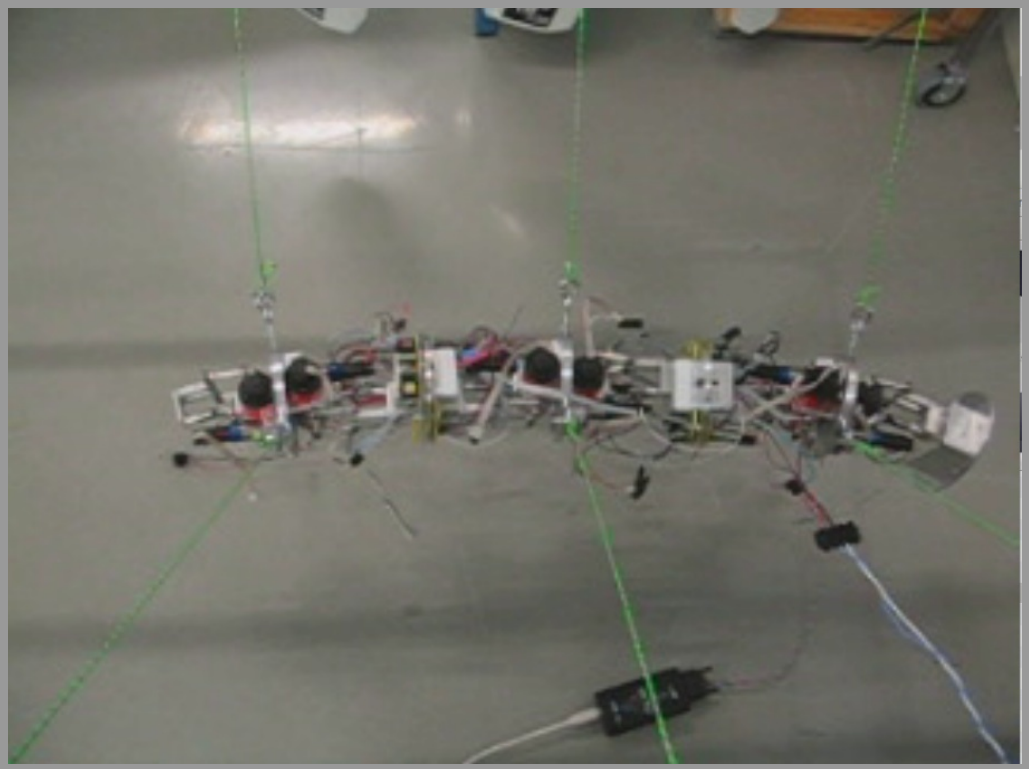

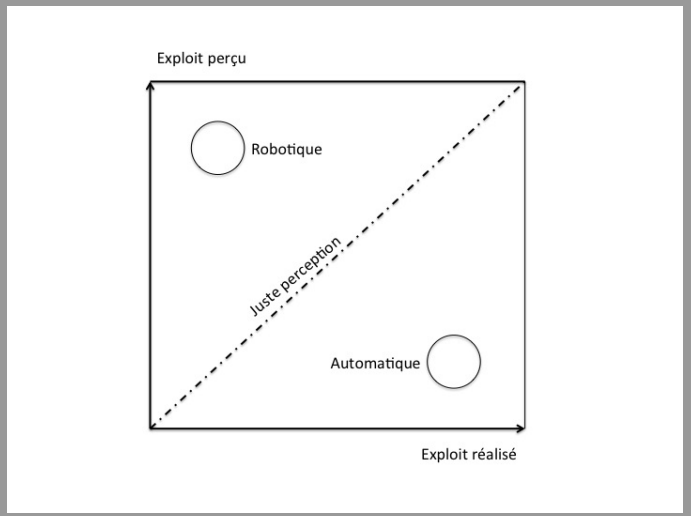

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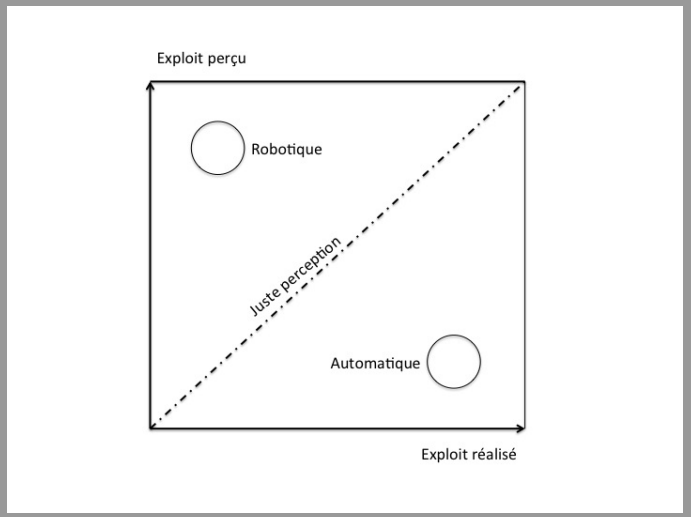

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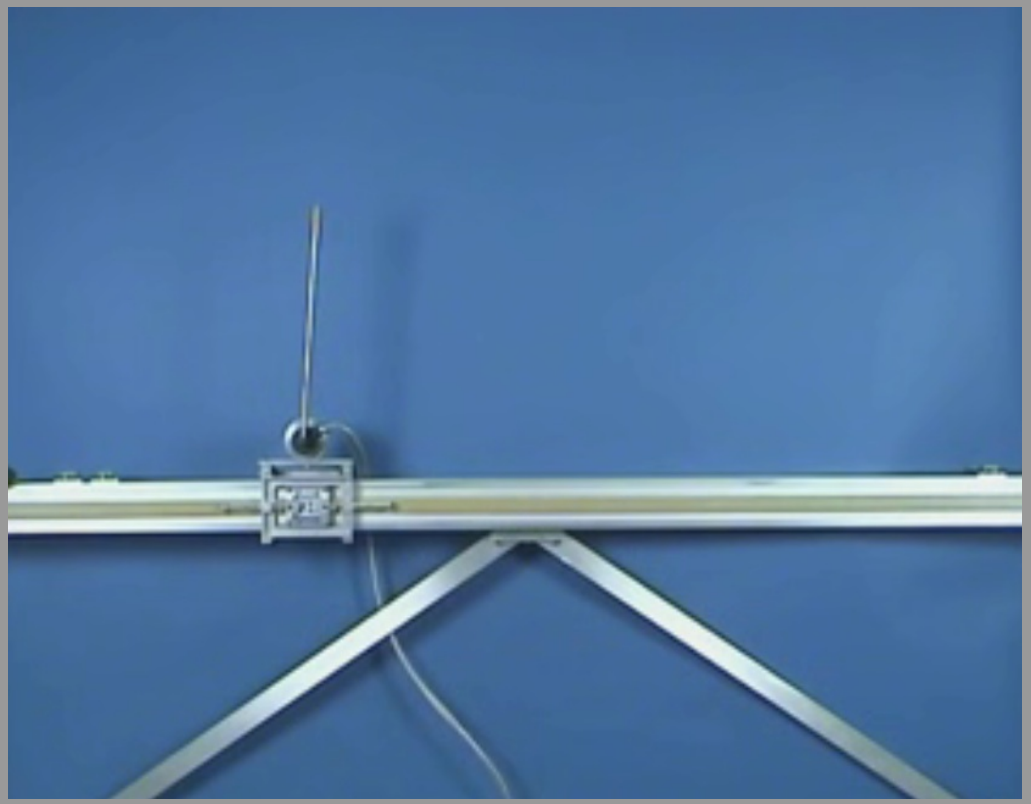
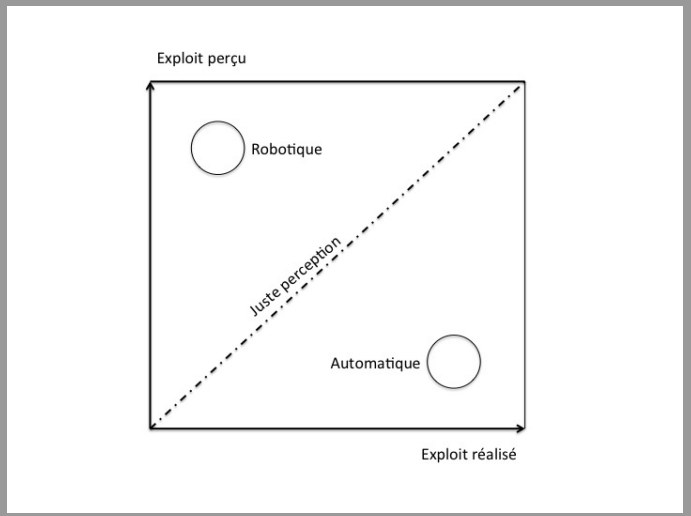
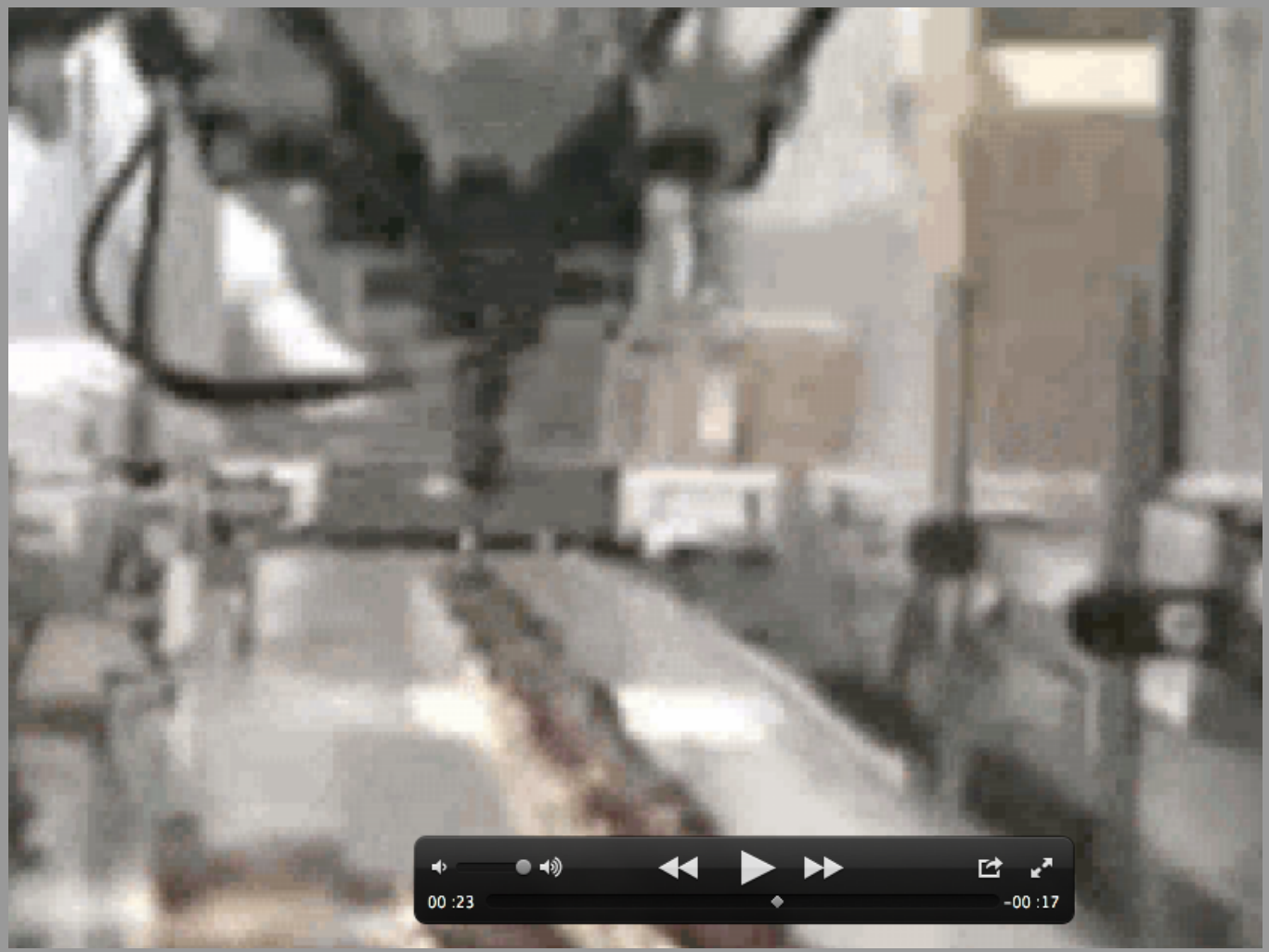




Exemple 1: Robot chocolatier (Quad Cell s650)



Exemple 2: Robot chirurgien (Da Vinci)...

Schéma de principe

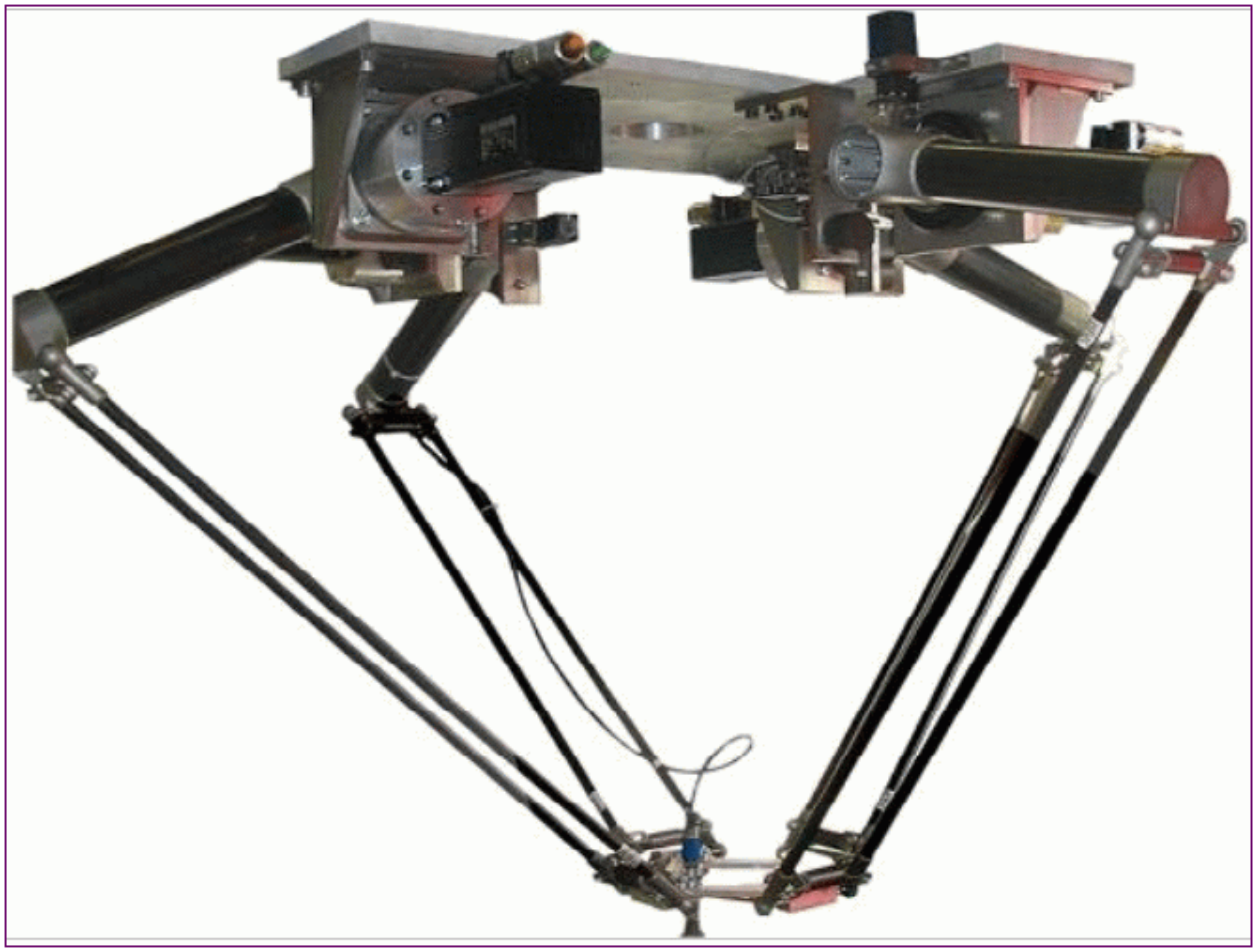


Schéma de principe

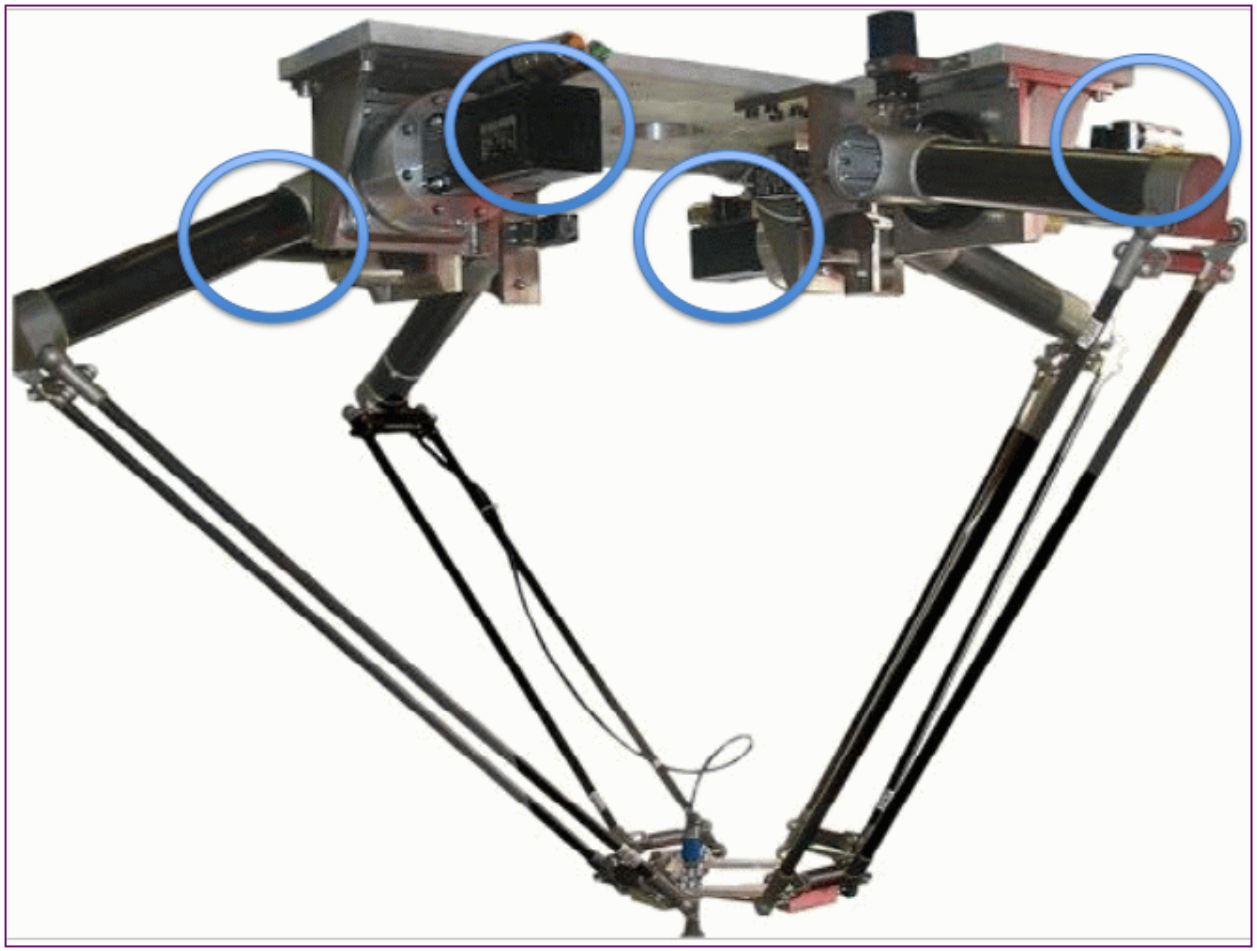


Schéma de principe

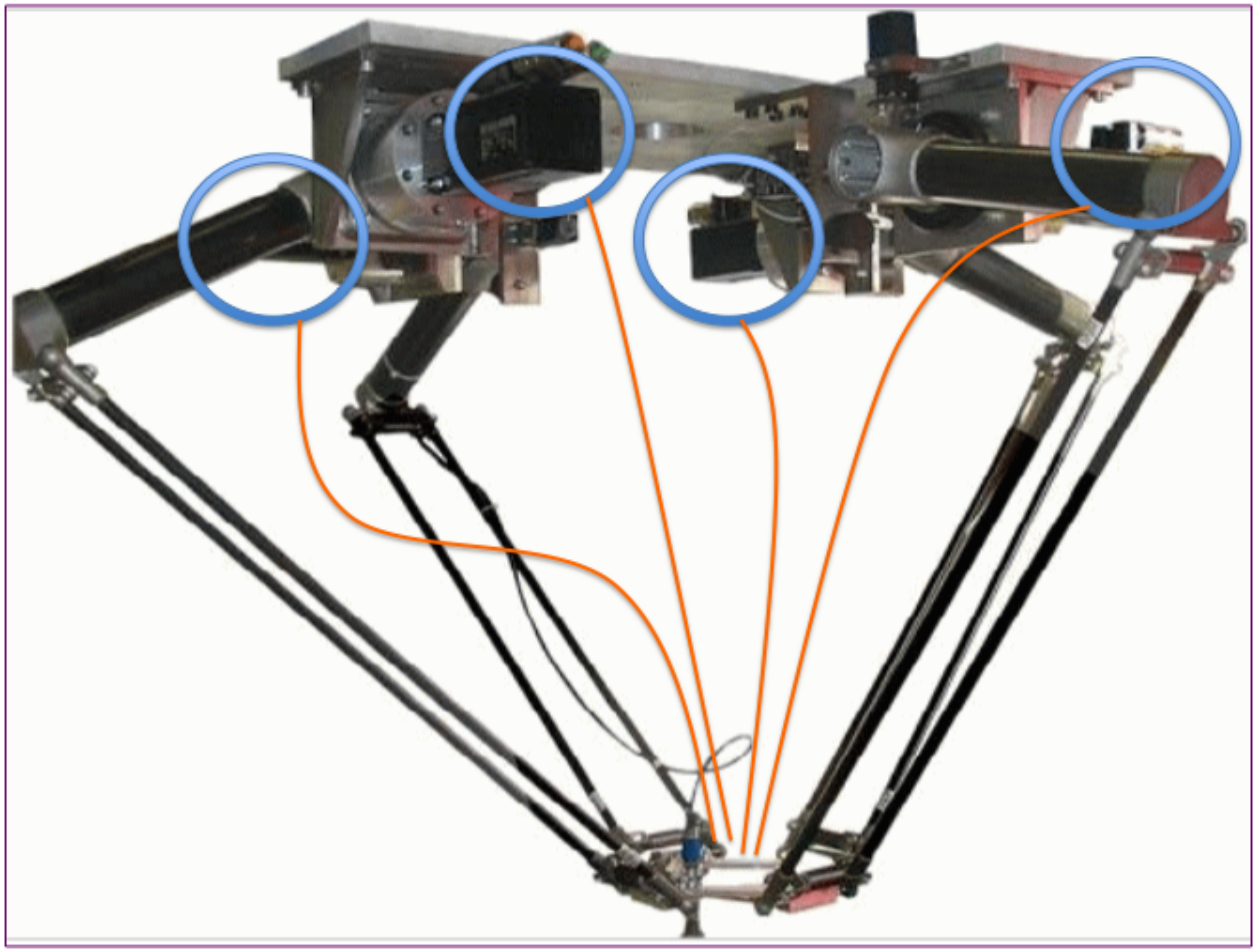


Schéma de principe

A l'échelle de la millième de secondes,
et compte tenu de l'information disponible,
Que doit-on demander à chaque actionneur
pour que la tâche soit accomplie ?

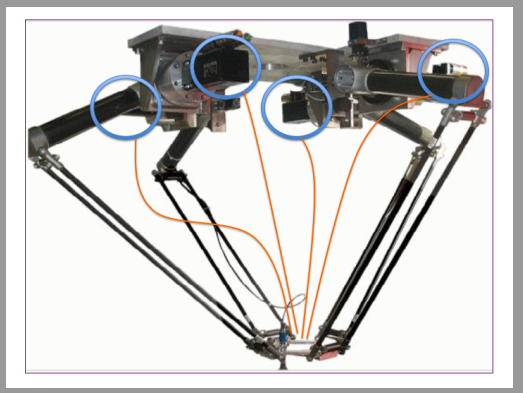


Schéma de principe

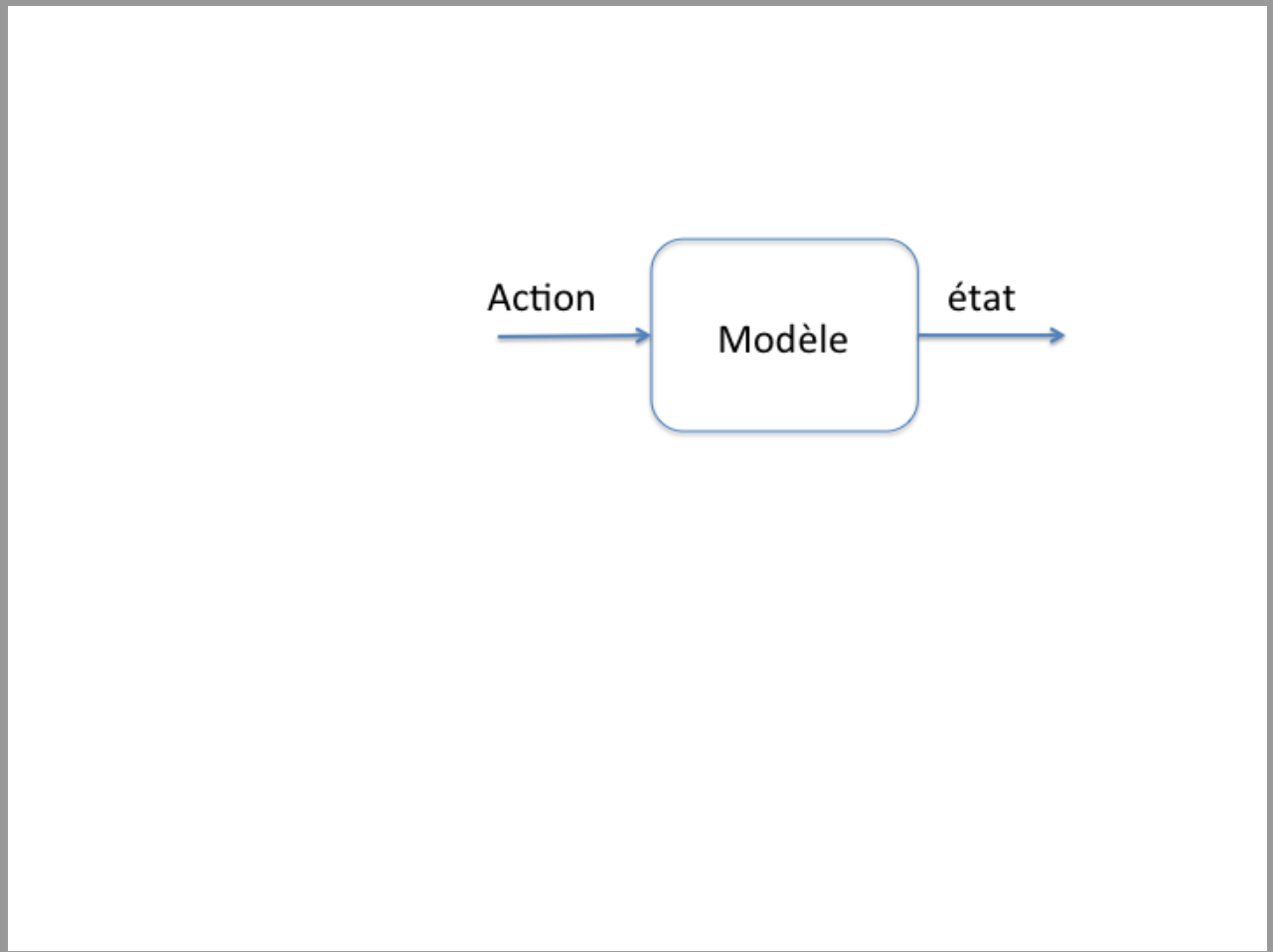


Schéma de principe

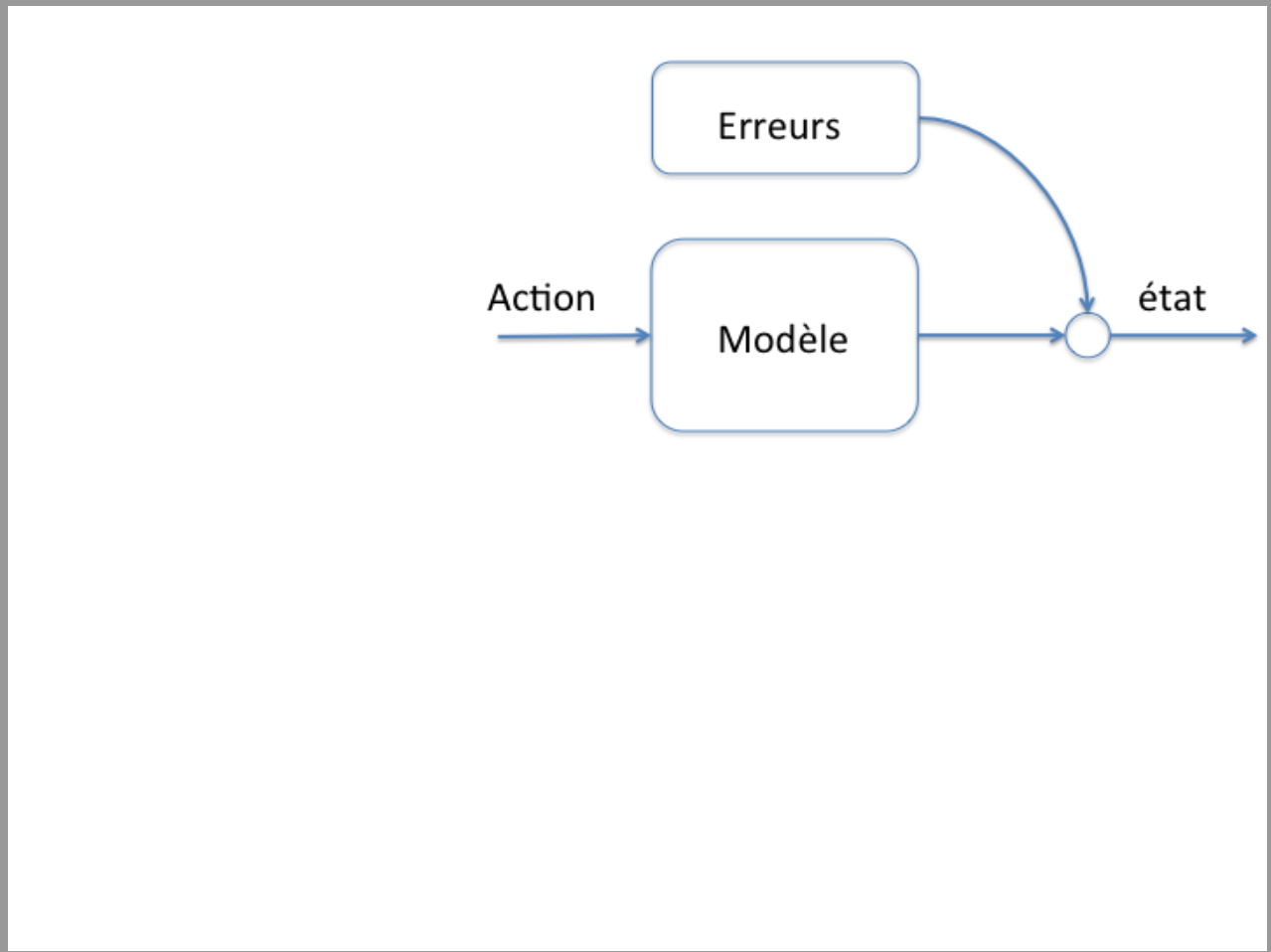
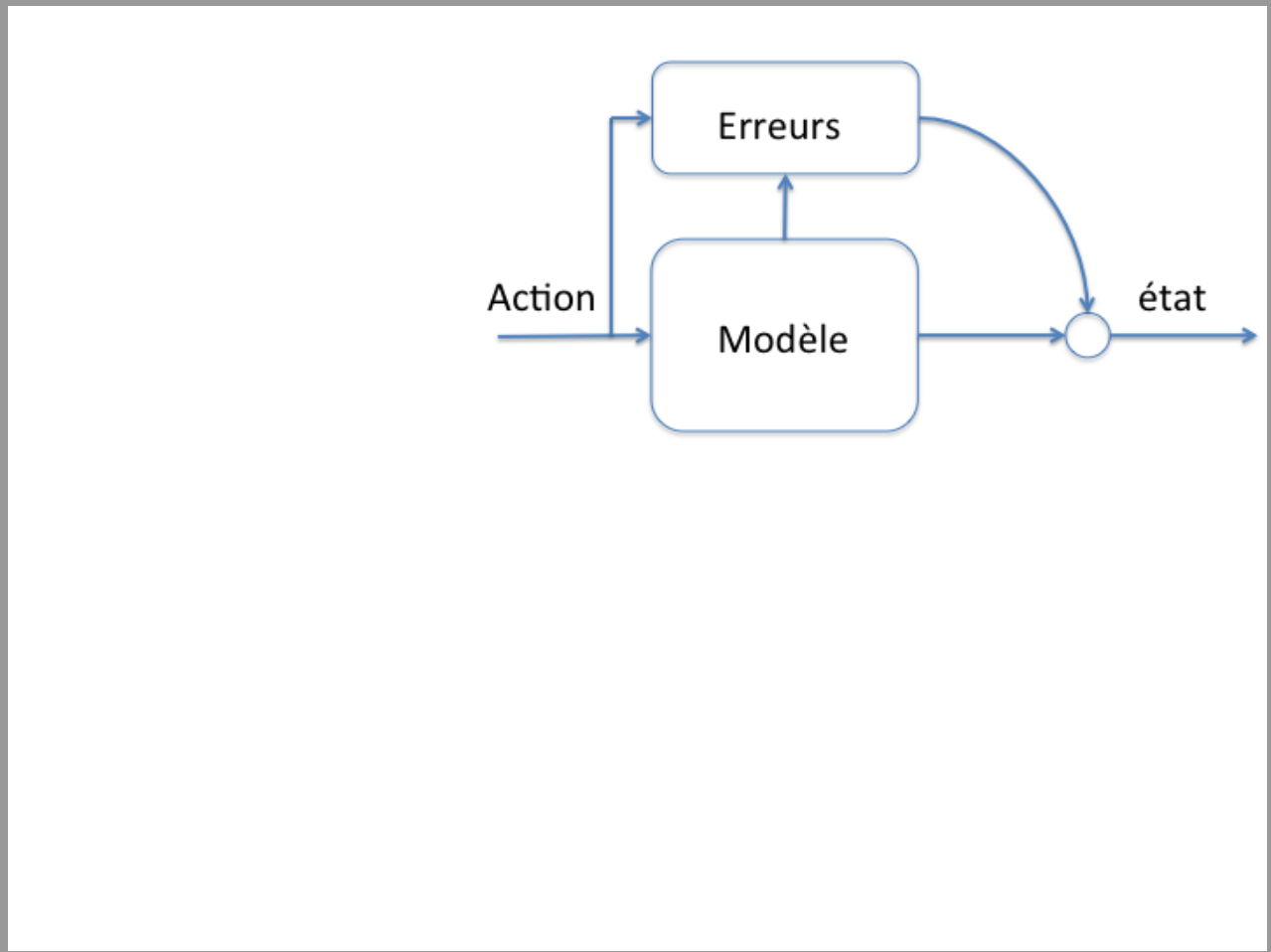


Schéma de principe



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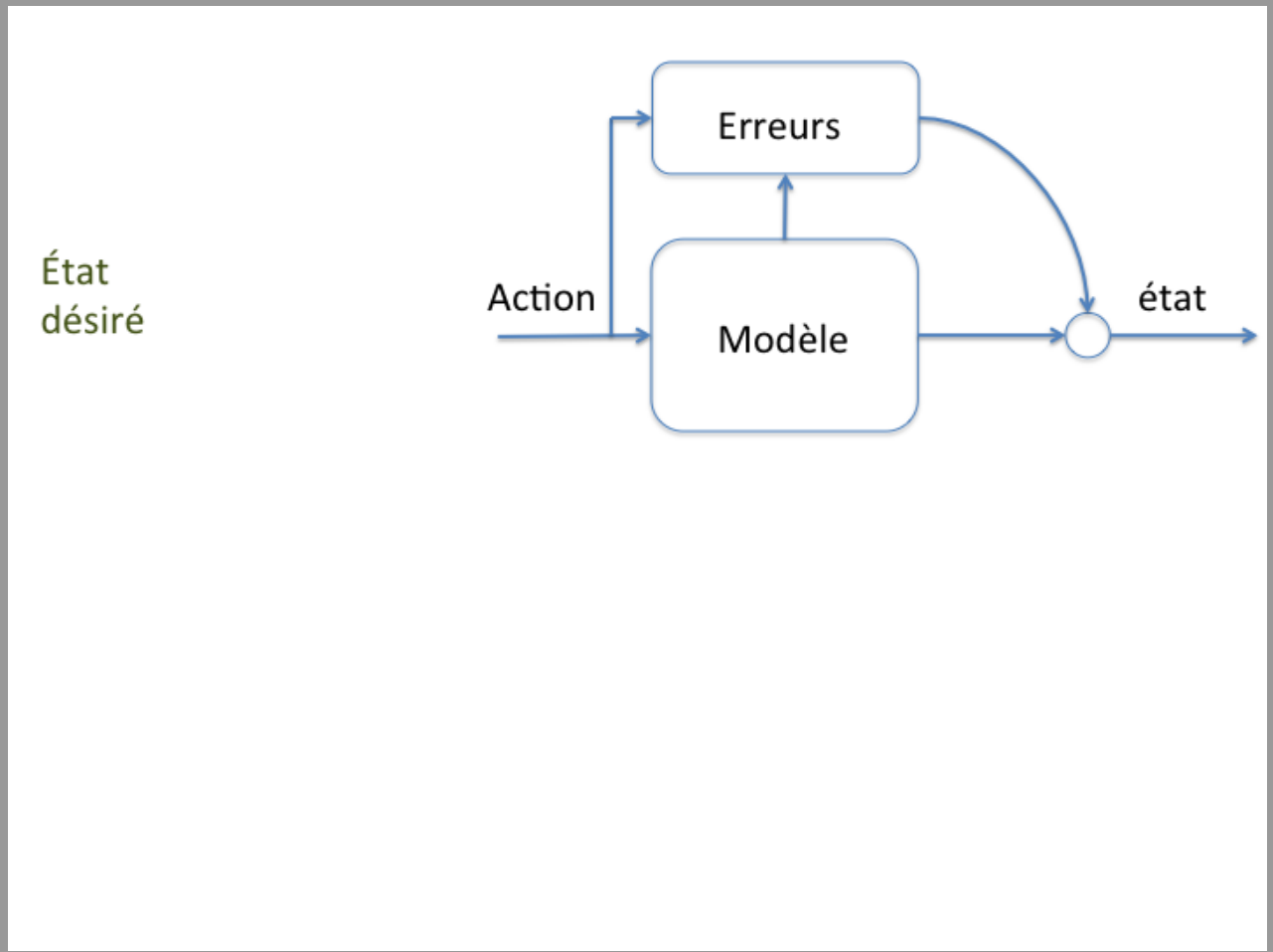
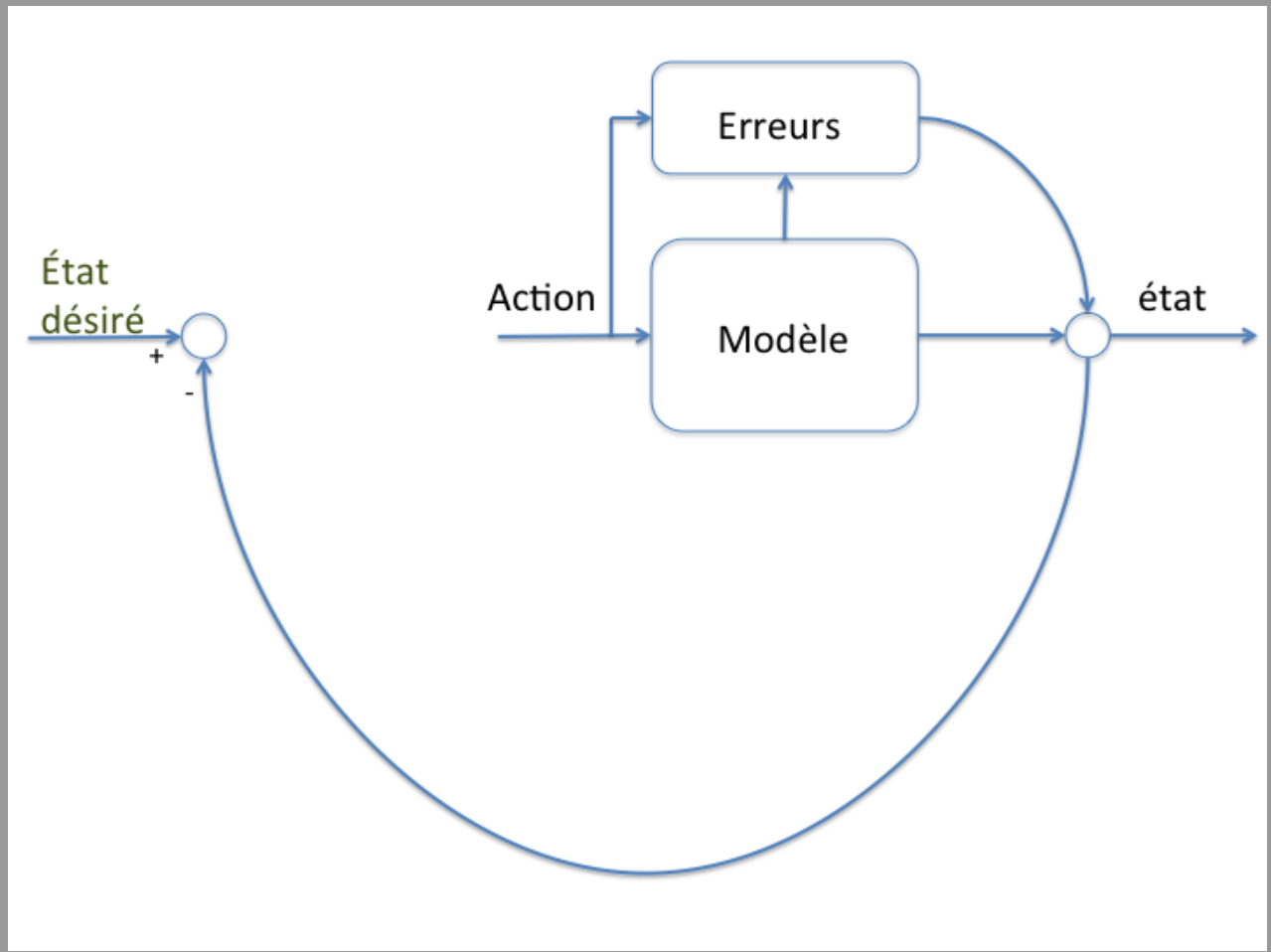


Schéma de principe



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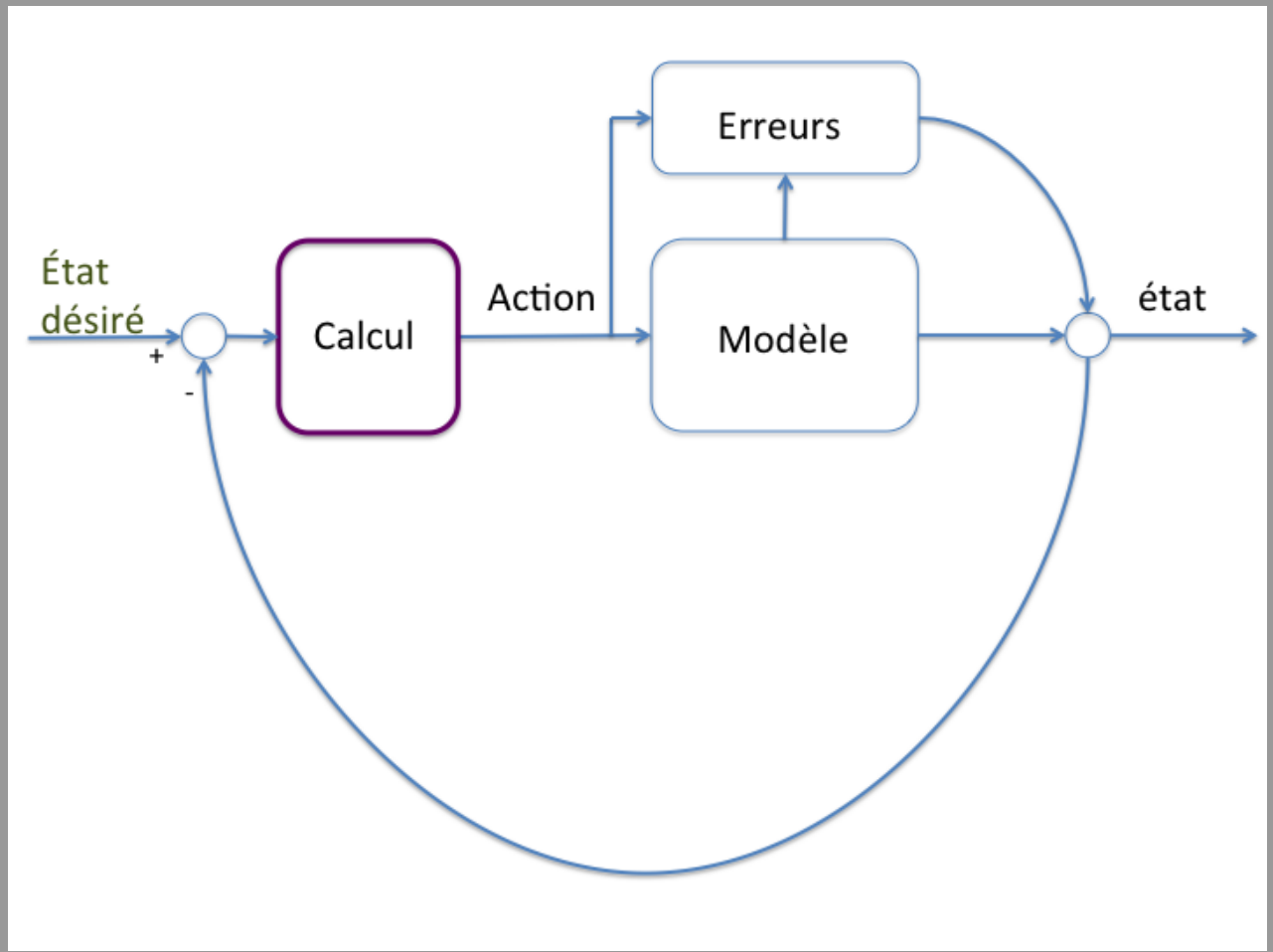
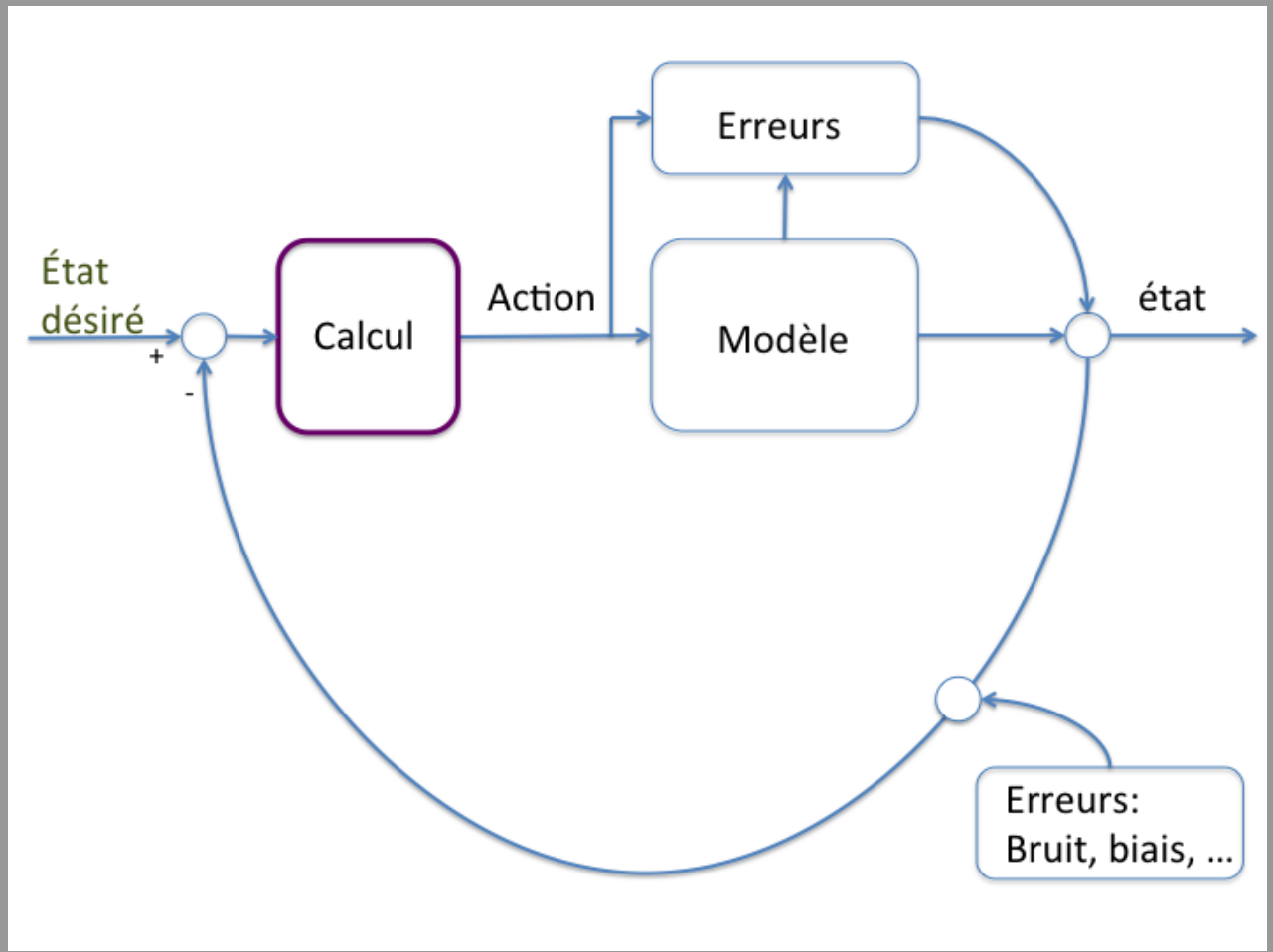


Schéma de principe



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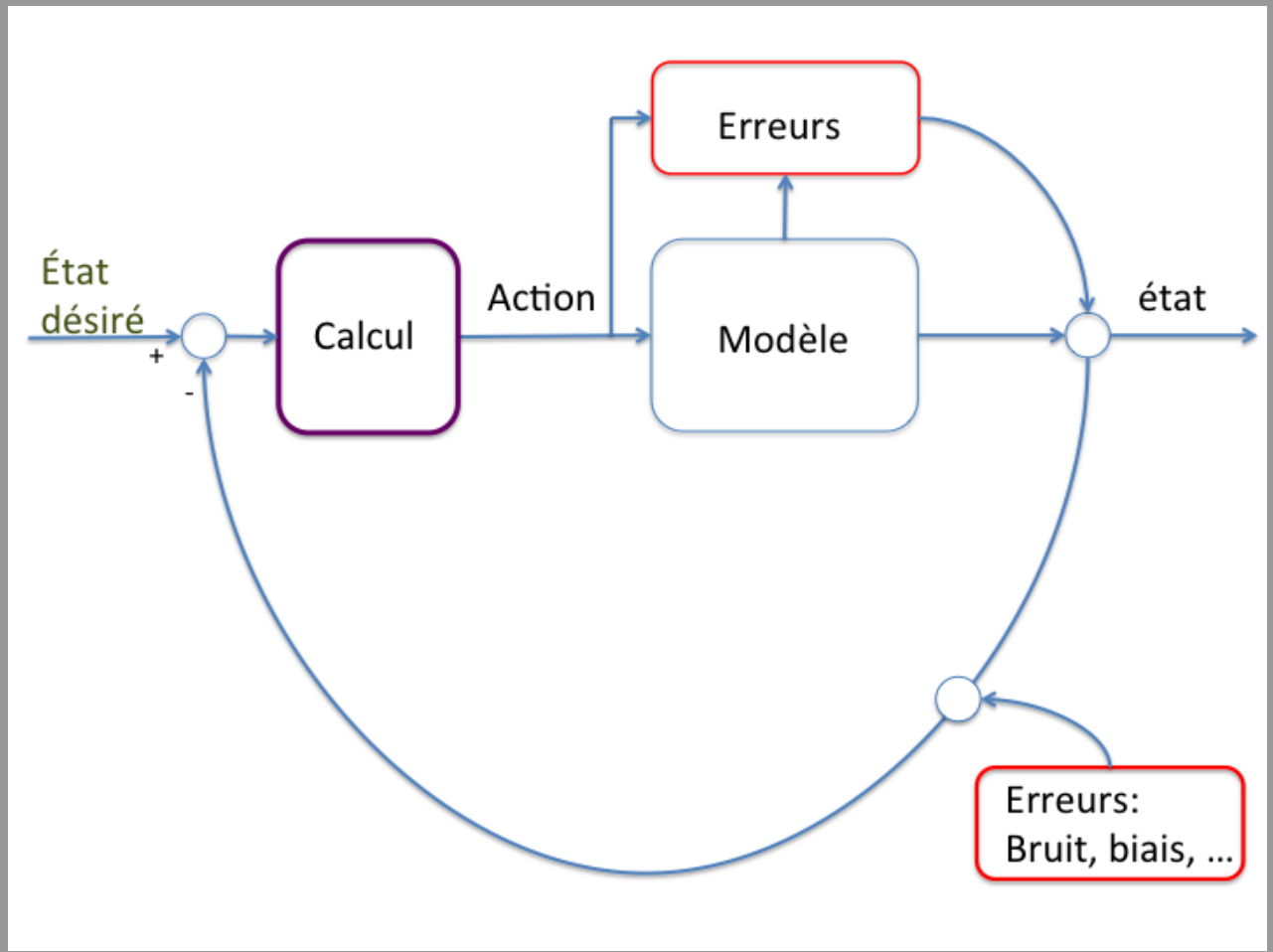

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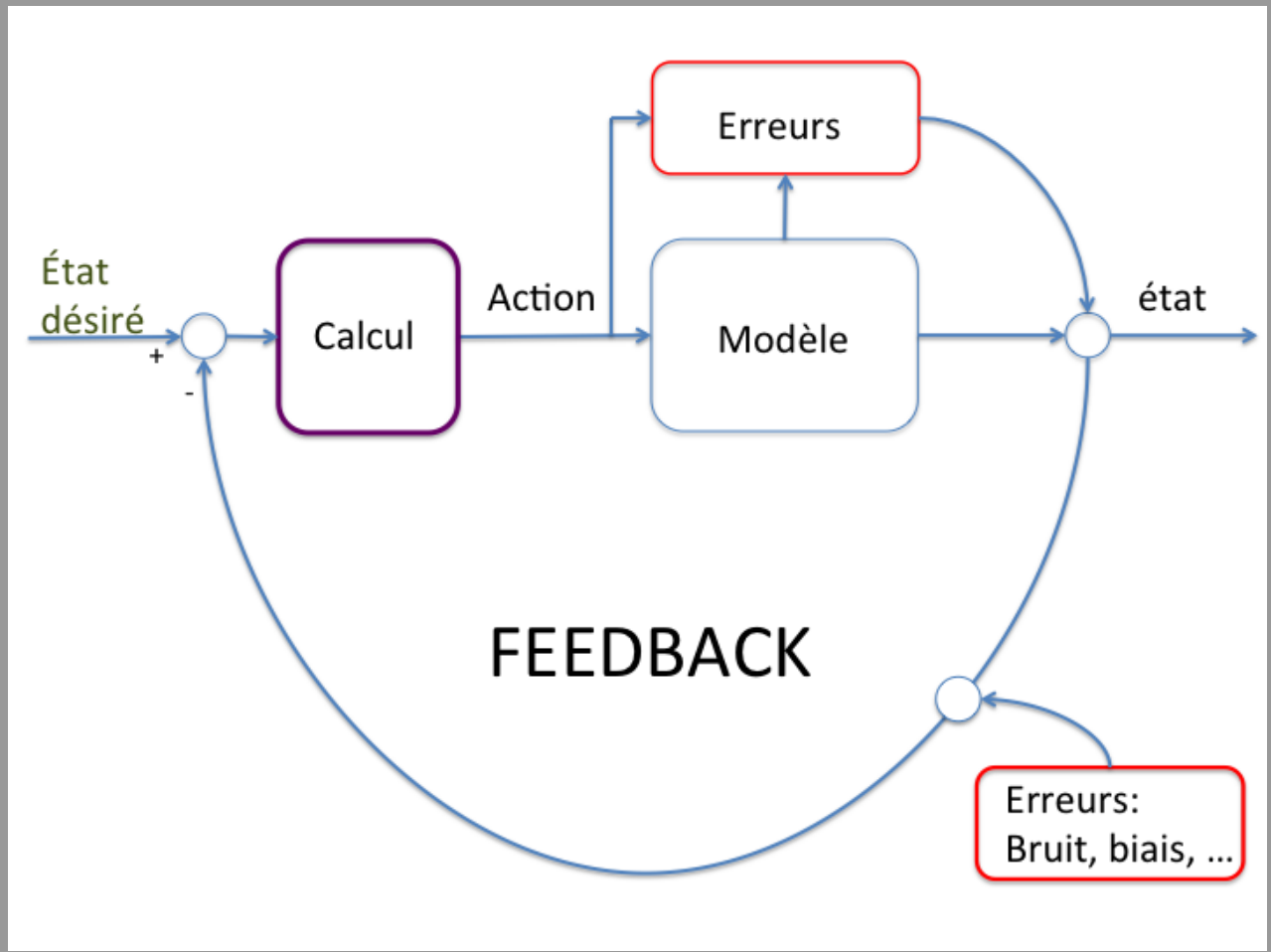
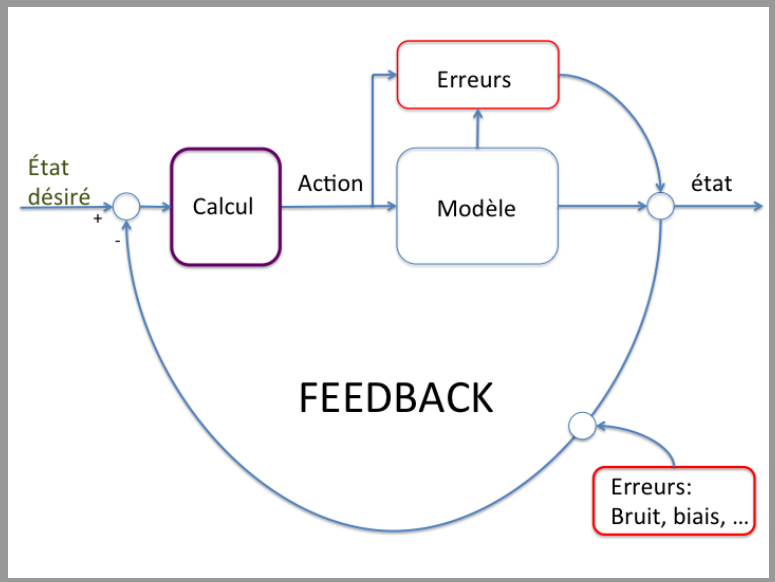


Mots clefs

- Modèle dynamique
- Erreurs de modèle
- Mesures, bruits de mesures,
- perturbations, incertitudes,
- Stabilité
- Robustesse
- Performance
- Optimisation
- Temps-réel
- Estimation, Identification
- **Feedback**



De l'automatique pour la robotique: un exemple

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Discrete-time bilateral teleoperation: modelling and stability analysis

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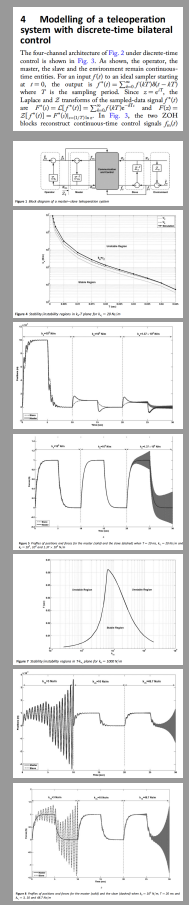
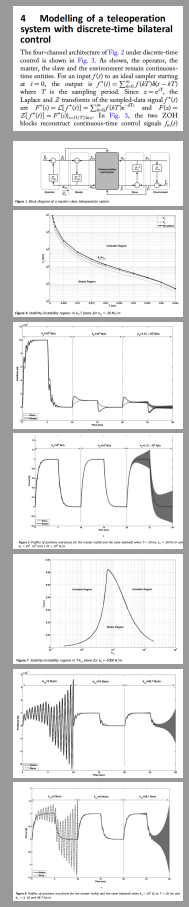
Abstract: Discretisation of a stabilising continuous-time bilateral teleoperation controller for digital implementation may not necessarily lead to stable teleoperation. While previous research has focused on the



De l'automatique à la robotique: un exemple

4 Modelling of a teleoperation system with discrete-time bilateral control

The four-channel architecture of Fig. 2 under discrete-time control is shown in Fig. 3. As shown, the operator, the master, the slave and the environment remain continuous-time entities. For an input $f(t)$ to an ideal sampler starting at $t = 0$, the output is $f^*(t) = \sum_{k=0}^{\infty} f(kT)\delta(t - kT)$ where T is the sampling period. Since $z = e^{sT}$, the Laplace and $\mathcal{Z}$ transforms of the sampled-data signal $f^*(t)$ are $F^*(s) = \mathcal{L}[f^*(t)] = \sum_{k=0}^{\infty} f(kT)e^{-kTs}$ and $F(z) = \mathcal{Z}[f^*(t)] = F^*(s)|_{s=(1/T)\ln z}$. In Fig. 3, the two ZOH blocks reconstruct continuous-time control signals $f_m(t)$



De l'automatique à la robotique: un exemple

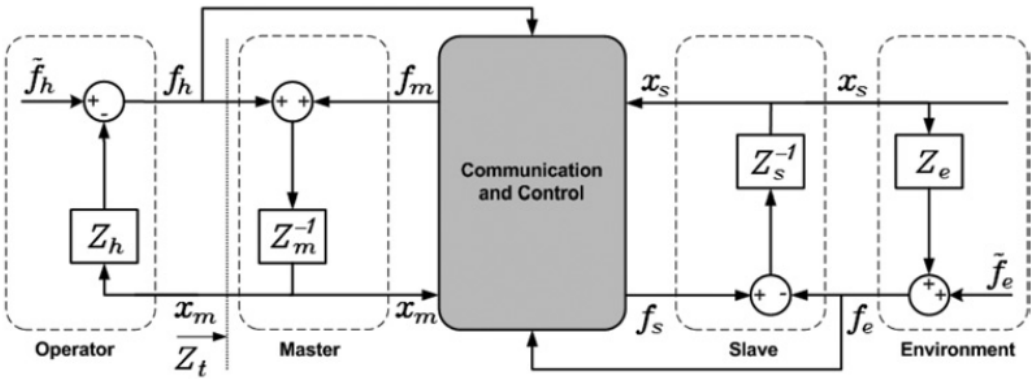
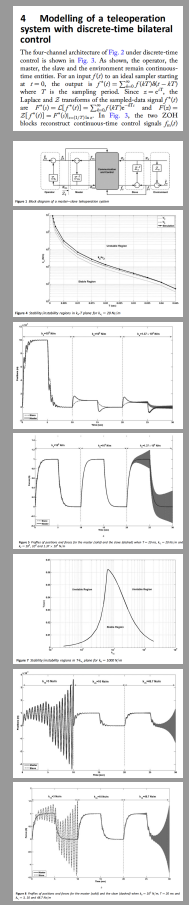


Figure 1 *Block diagram of a master–slave teleoperation system*



De l'automatique à la robotique: un exemple

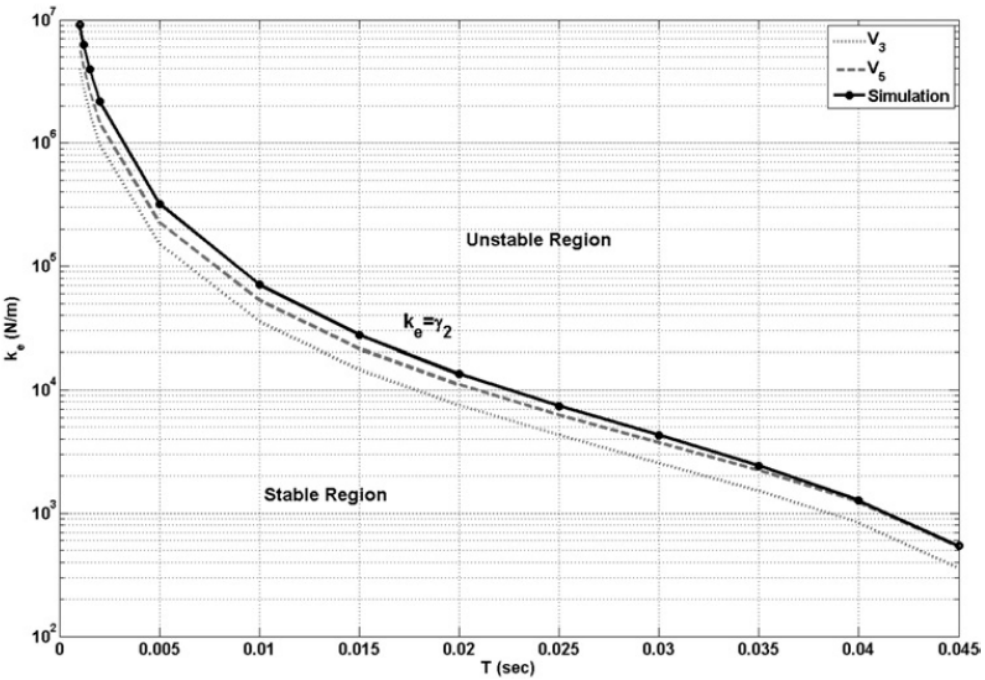
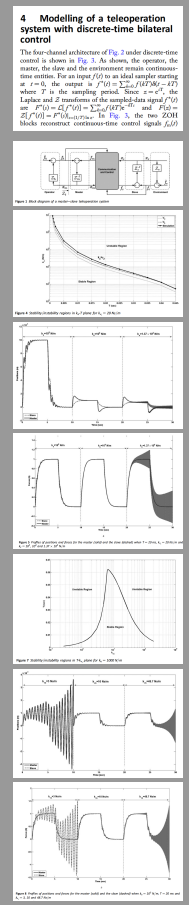


Figure 4 *Stability/instability regions in k_e-T plane for $k_{v_s} = 20\ Ns/m$*



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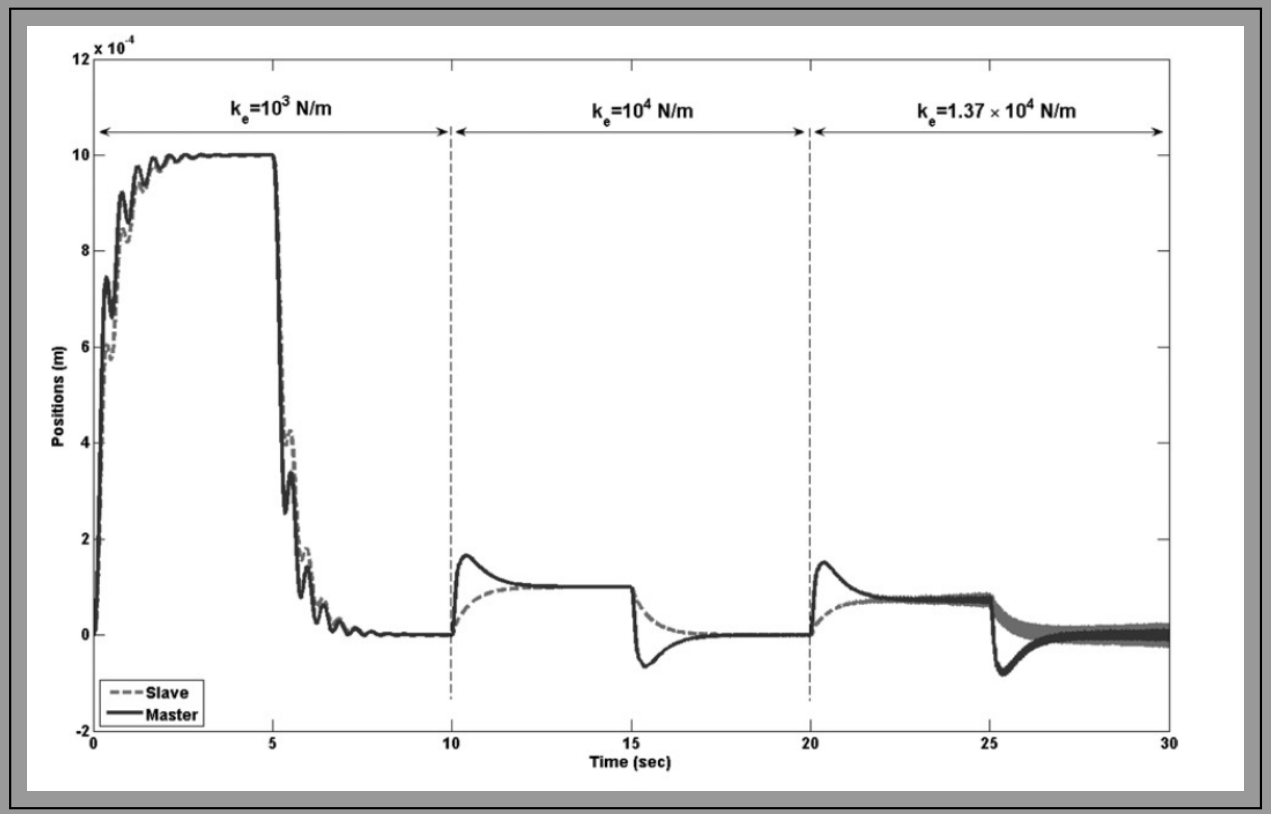
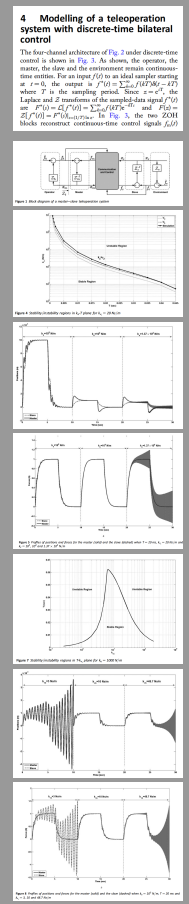




De l'automatique à la robotique: un exemple

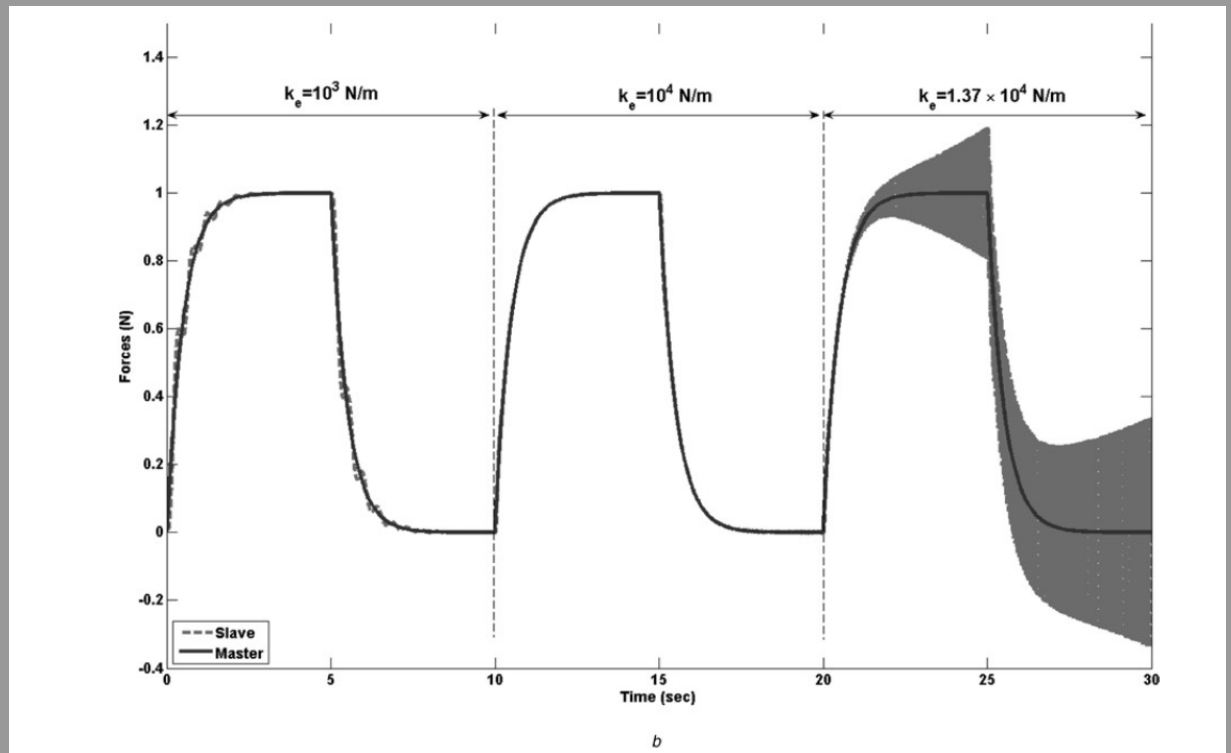
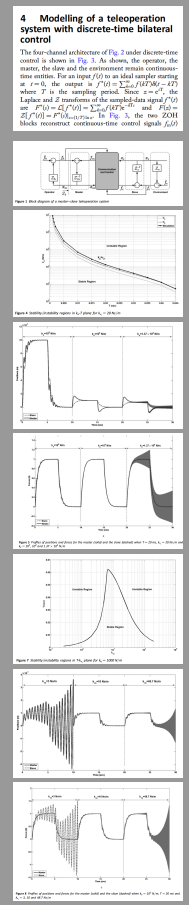


Figure 5 *Profiles of positions and forces for the master (solid) and the slave (dashed) when $T = 20$ ms, $k_{v_s} = 20$ Ns/m and $k_e = 10^3$, 10^4 and 1.37×10^4 N/m*



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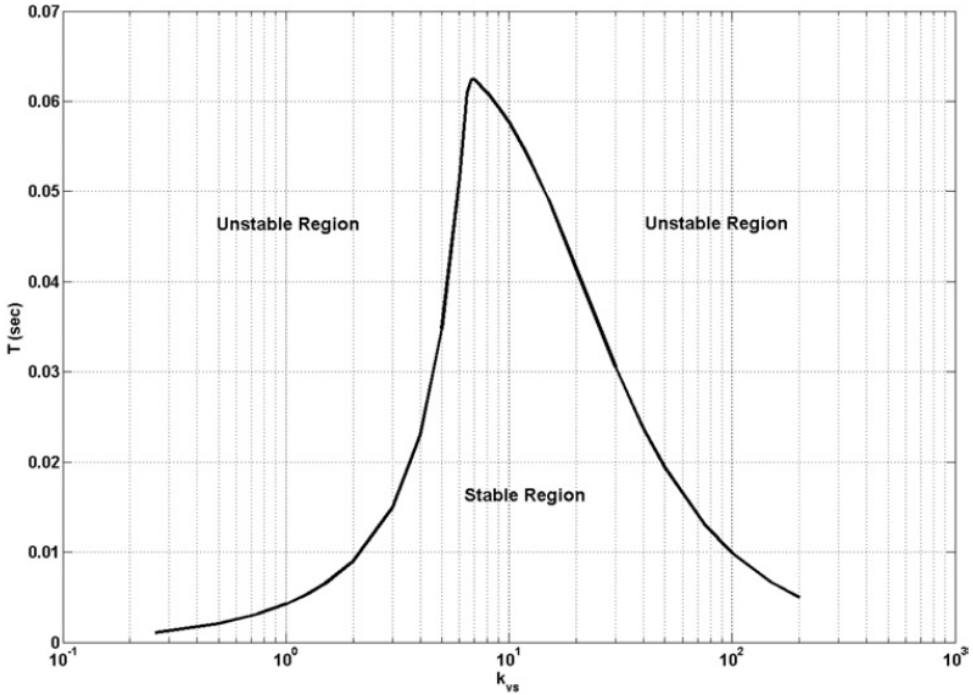
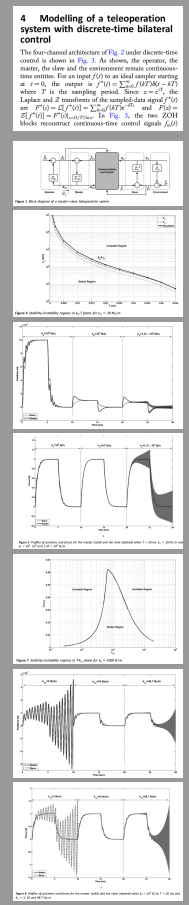
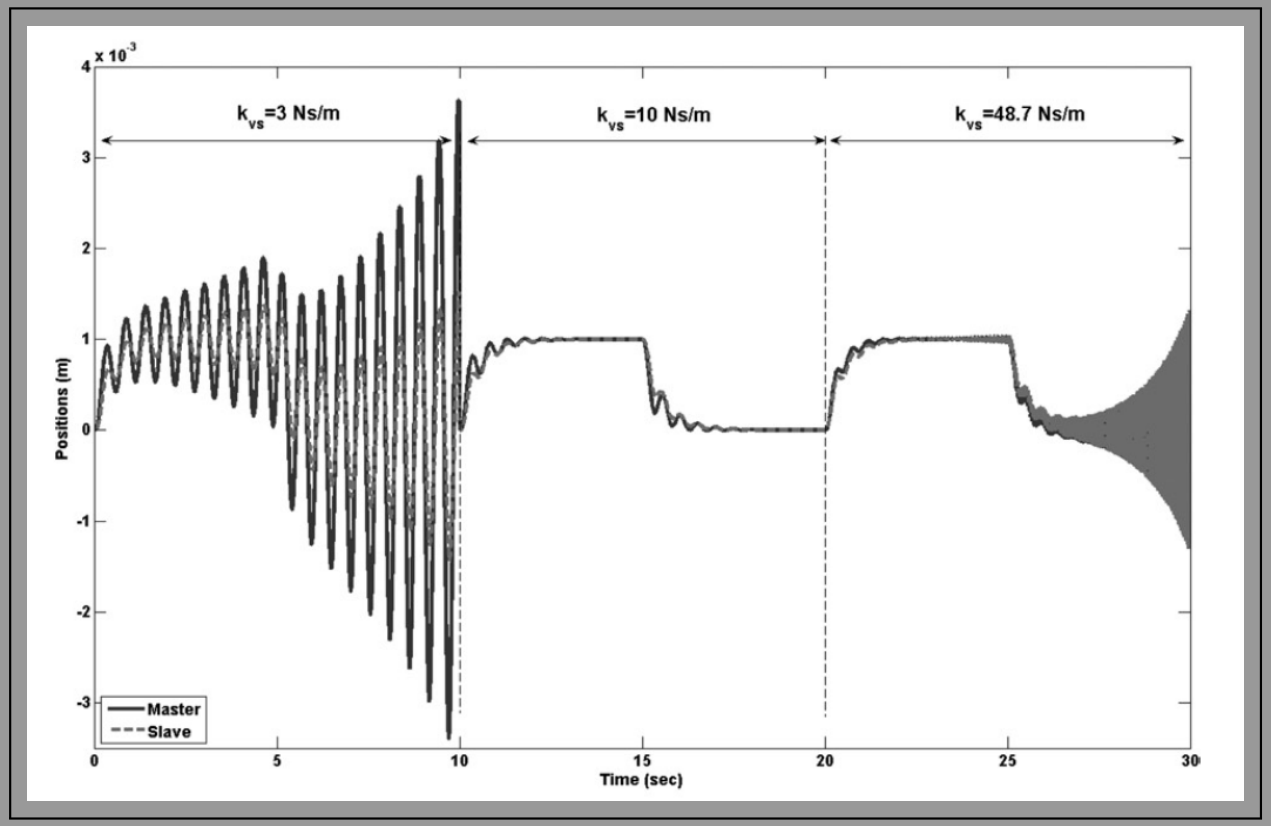
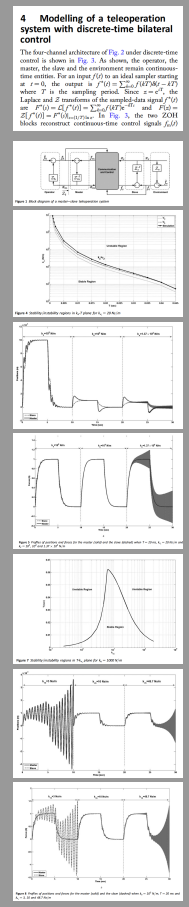


Figure 7 *Stability/instability regions in T-k_{v_s} plane for $k_e = 1000\ N/m$*



De l'automatique à la robotique: un exemple





De l'automatique à la robotique: un exemple

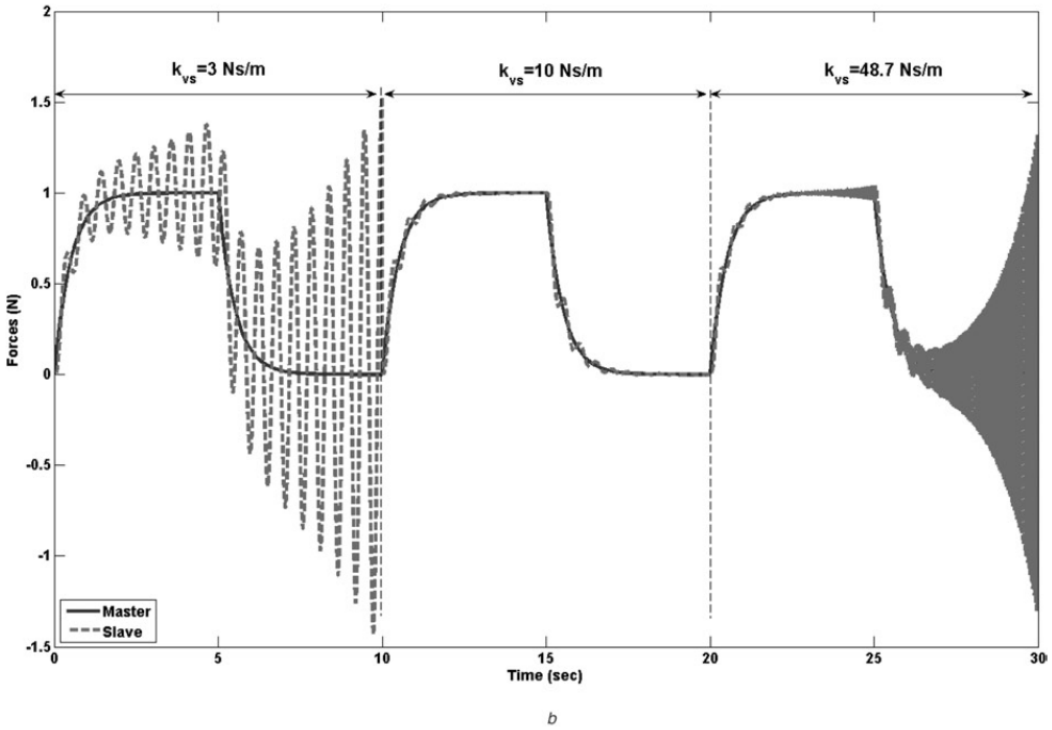
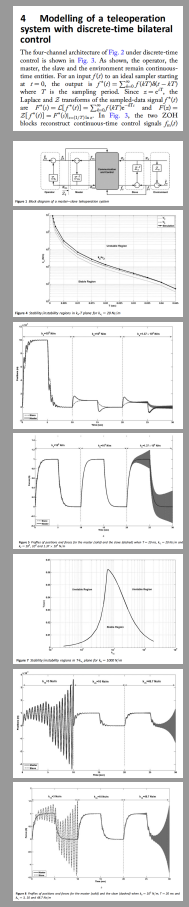
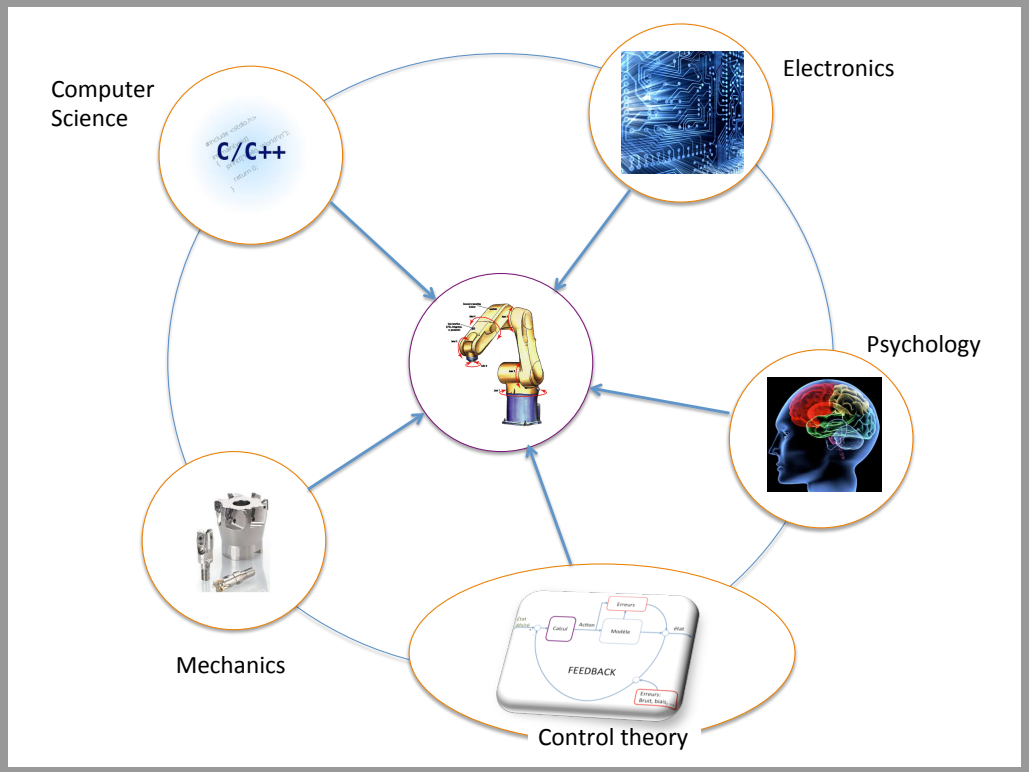


Figure 8 *Profiles of positions and forces for the master (solid) and the slave (dashed) when $k_e = 10^3$ N/m, $T = 20$ ms and $k_{v_s} = 3$, 10 and 48.7 Ns/m*

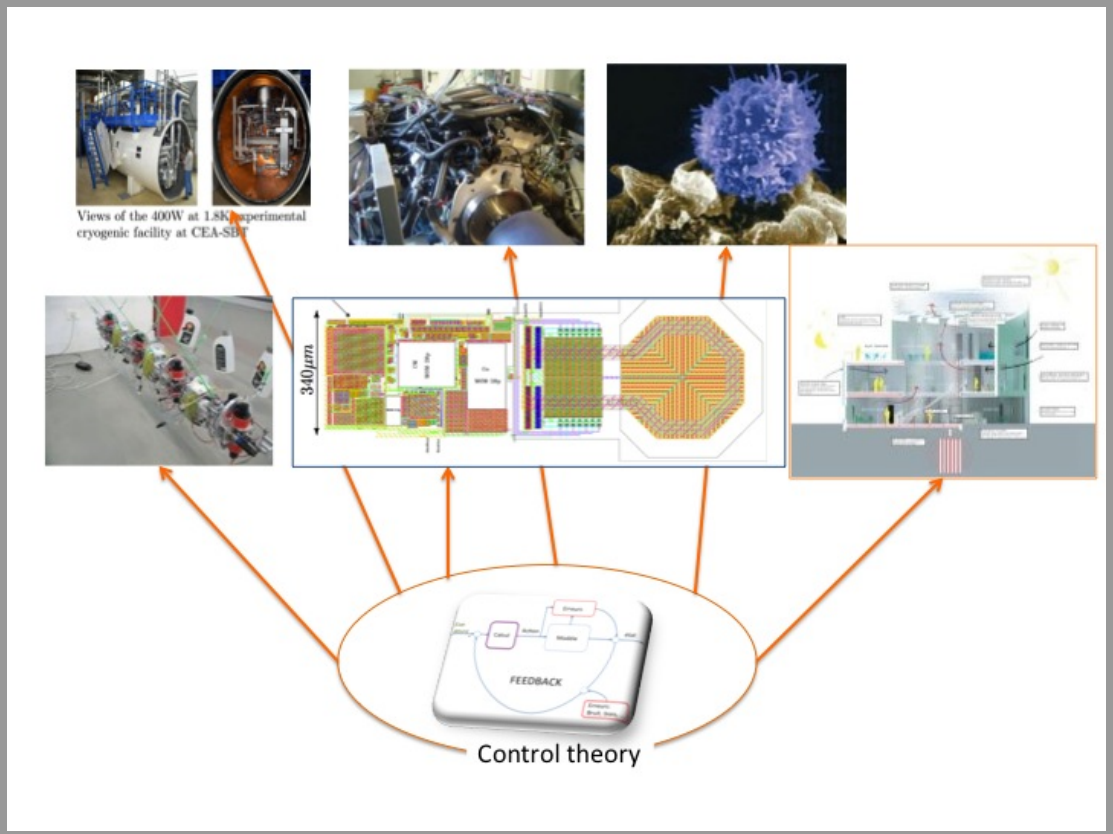


Robotique: Intégration de technologie



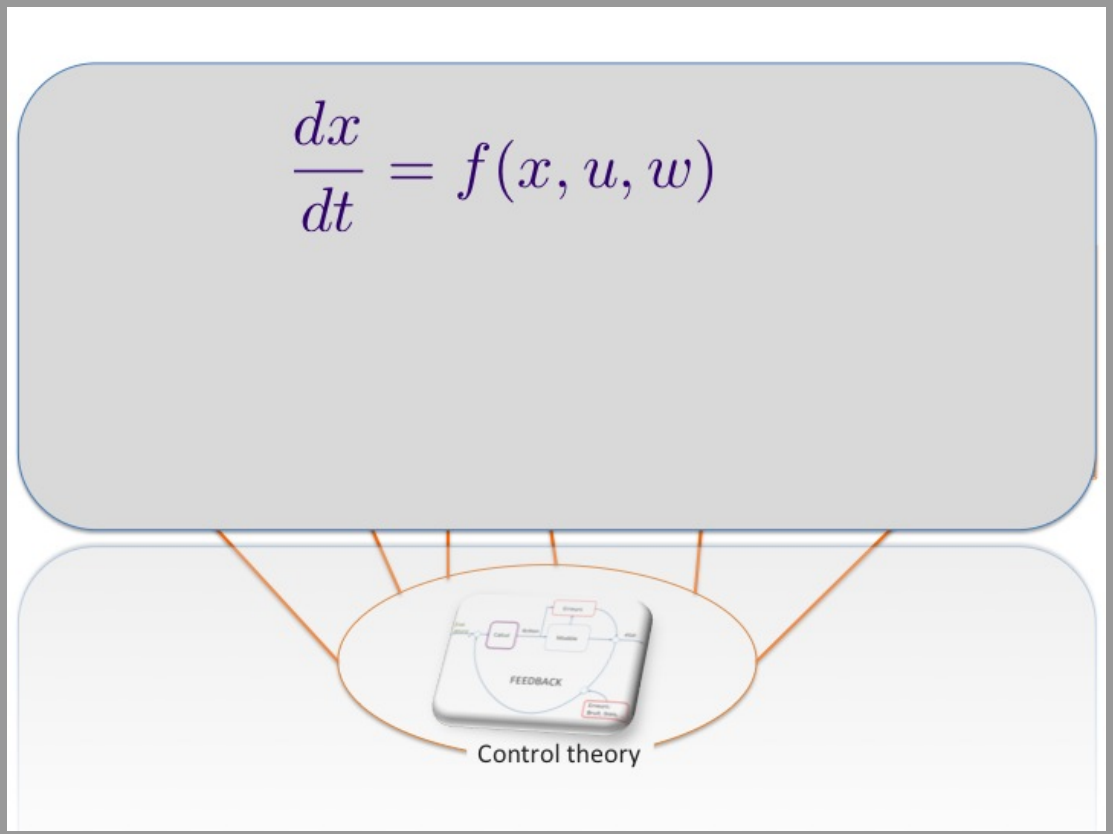
Un robot intègre plusieurs technologies au service d'une tâche

Automatique: Une méthodologie transverse



L'automatique effectue une abstraction en vue de mettre en œuvre des solutions génériques

Automatique: Une méthodologie transverse



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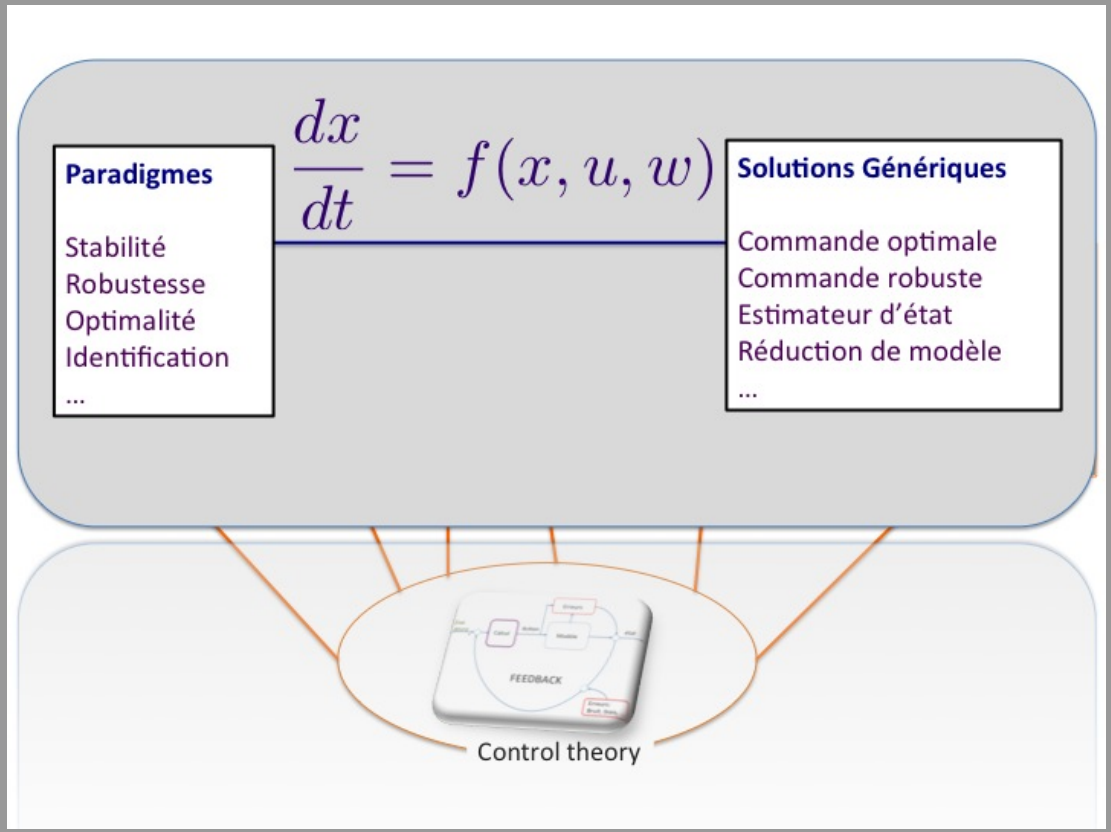
Automatique: Une méthodologie transverse



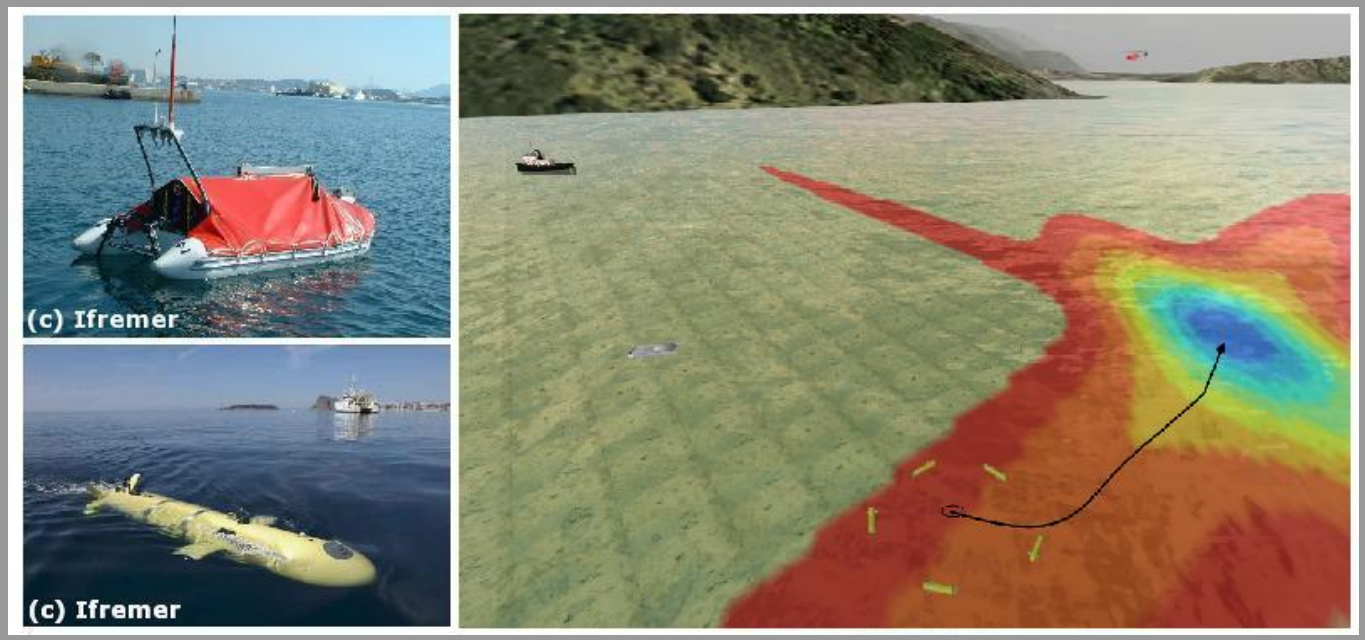
L'automatique effectue une abstraction en vue de mettre en œuvre des solutions génériques

Les tendances . . .

- Distribution / Coordination

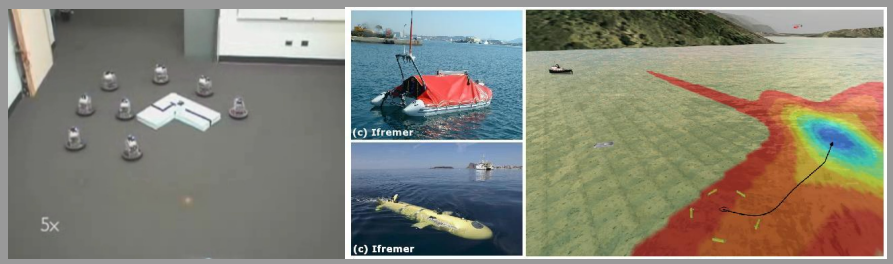
Les tendances . . .

- Distribution / Coordination



Les tendances . . .

- Distribution / Coordination

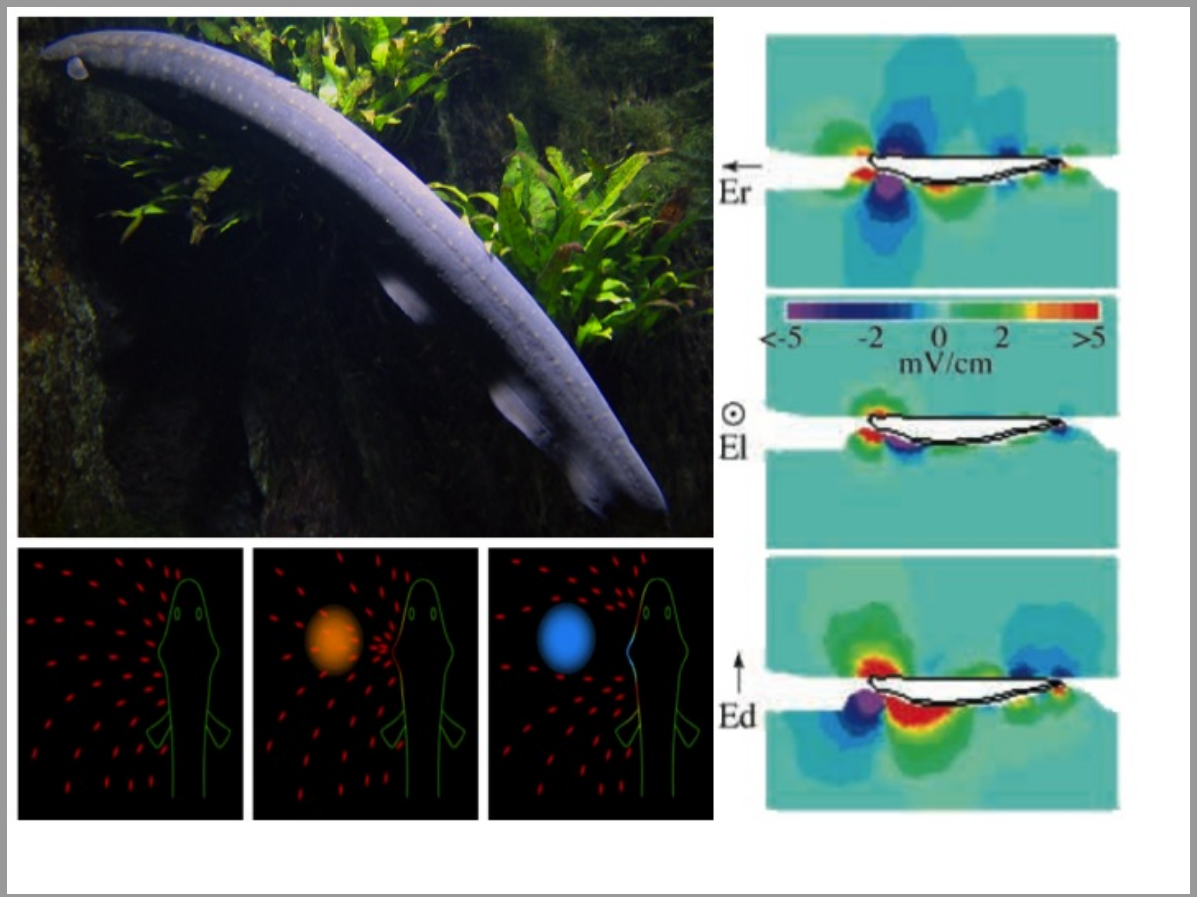


Mots clés

- Convergence vers un consensus (stabilité ?)
- Reconstruction d'information à partir de mesures partielles
- La dynamique à contrôler concerne:
  - les désaccords entre acteurs
  - la pertinence d'une hypothèse de travail
  - . . .

Les tendances . . .

- Distribution / Coordination
- Autonomie / Perception par l'action / Bio-mimétisme



Problème Direct:

$$I = F(U, \text{configuration})$$

Problème Inverse:

$$\text{configuration} = F^{-1}(U, I)$$

De meilleurs titres . . .

- De l'automatique en robotique
- De la robotique à l'automatique
- Entre robotique et automatique

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Automatique & Robotique, . . .

Une histoire qui commence à peine . . .