

Stage Master 2

Comment découvrir son corps ?

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Équipe : LARSEN

Introduction

Travail Réalisé

Expérimentation

Conclusion

Introduction

Contexte

But : Monde réel

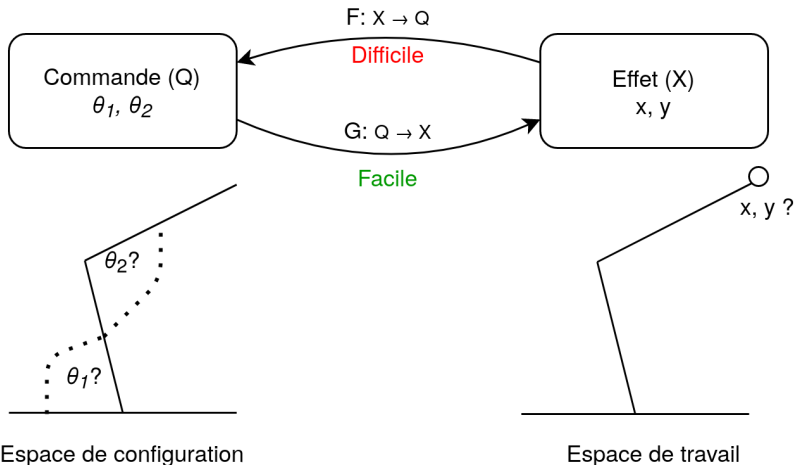
Robot : Commande

Fonction : Monde Réel \rightarrow Commande ?

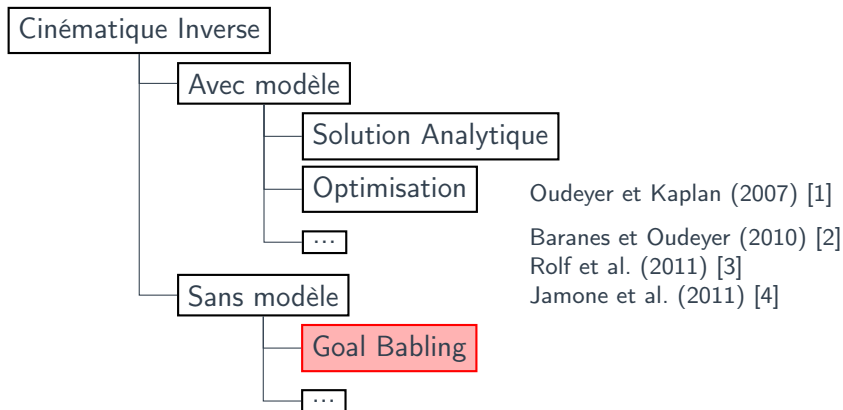


Cinématique Inverse

Exemple avec un bras robotique :



Cinématique Inverse



Poppy Ergo Jr



Goal Babling



Processus Développemental

Nouveau Q \rightarrow Nouveau X
 \hookrightarrow Nouvelle expérience

Travail Réalisé

Cinématique Inverse

Fonction :

Monde réel \rightarrow Commande

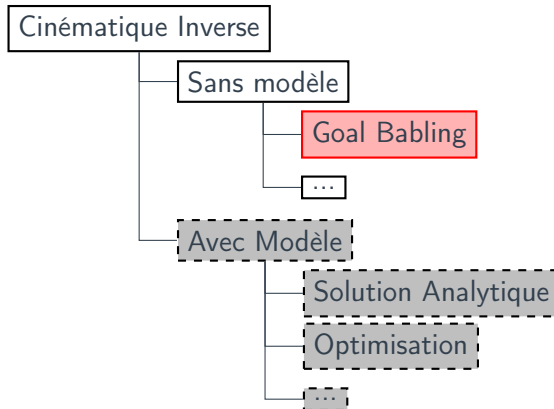
$$F : X \rightarrow Q$$

Expérience du robot

Catalogue

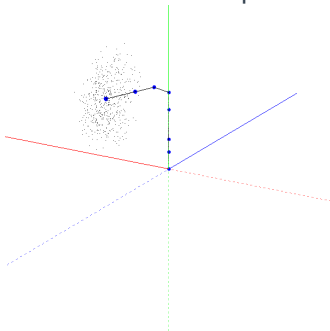
Observation (X)	Commande (Q)
x1, y1, z1	$\theta_{a1}, \theta_{b1}, \dots$
x2, y2, z2	$\theta_{a2}, \theta_{b2}, \dots$
x3, y3, z3	$\theta_{a3}, \theta_{b3}, \dots$
...	...

Comment construire F ?



Goal Babling

Perturbation d'une posture



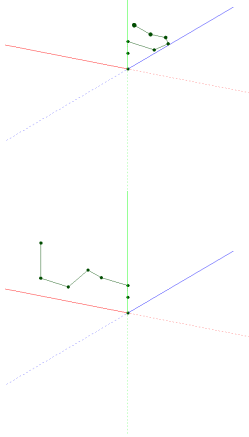
Suivre un but

Utilisation du Catalogue

Observation (X)	Commande (Q)
$x1, y1, z1$	$\theta_{a1}, \theta_{b1}, \dots$
$x2, y2, z2$	$\theta_{a2}, \theta_{b2}, \dots$
$x3, y3, z3$	$\theta_{a3}, \theta_{b3}, \dots$
...	...

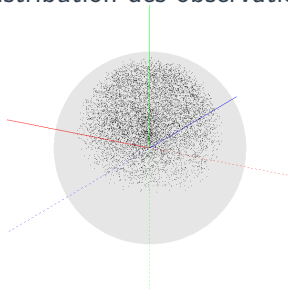
Motor Babling

Commande Aléatoire



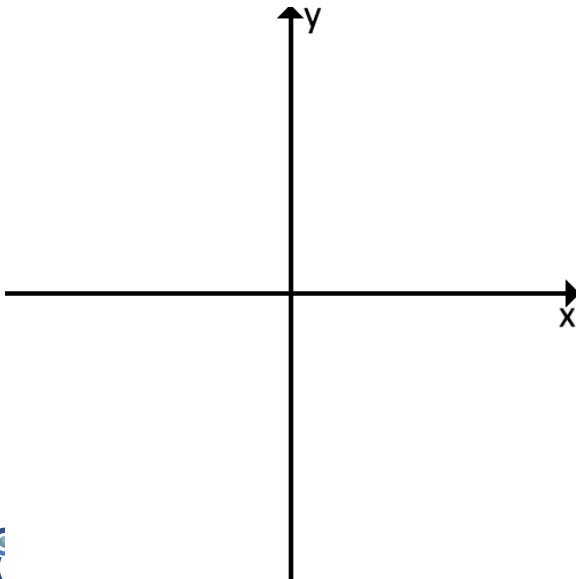
Initialisation du catalogue

Distribution des observations

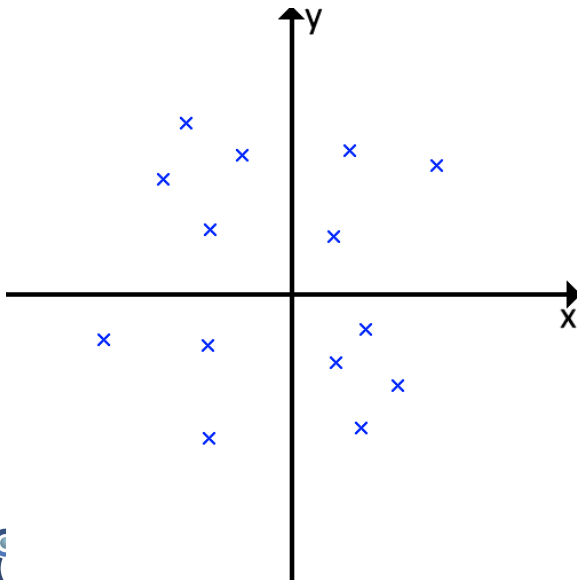


Agnostic Goal Generator

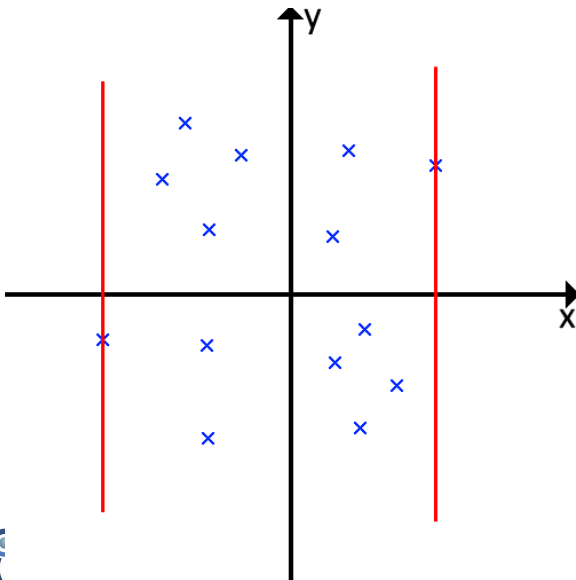
Agnostic Goal Generator



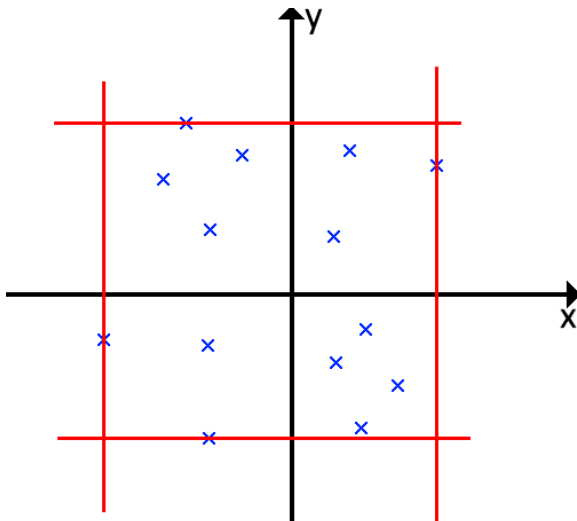
Agnostic Goal Generator



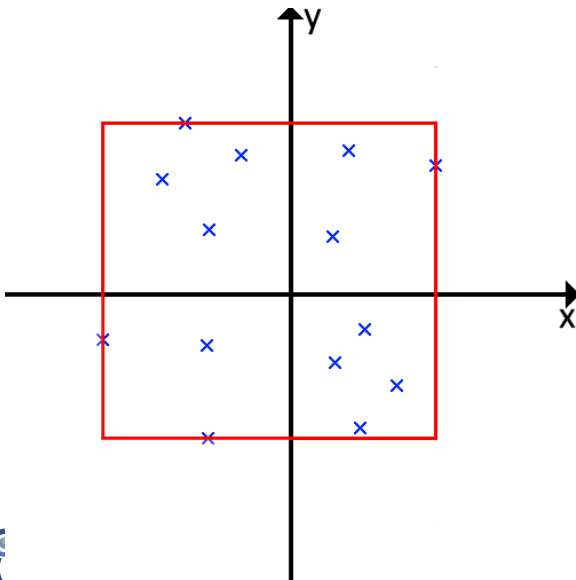
Agnostic Goal Generator



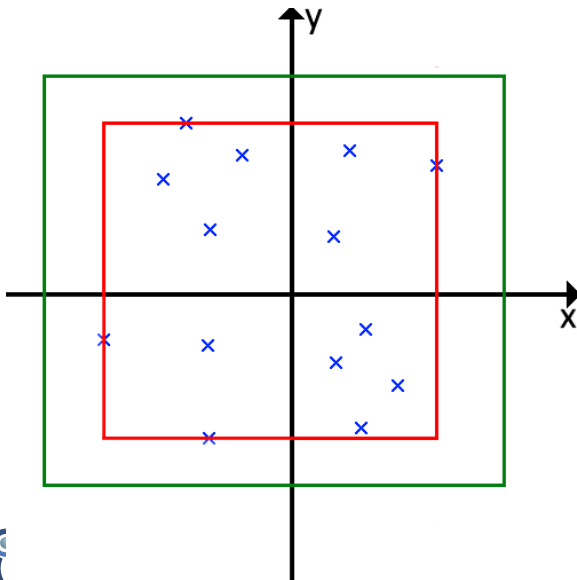
Agnostic Goal Generator



Agnostic Goal Generator

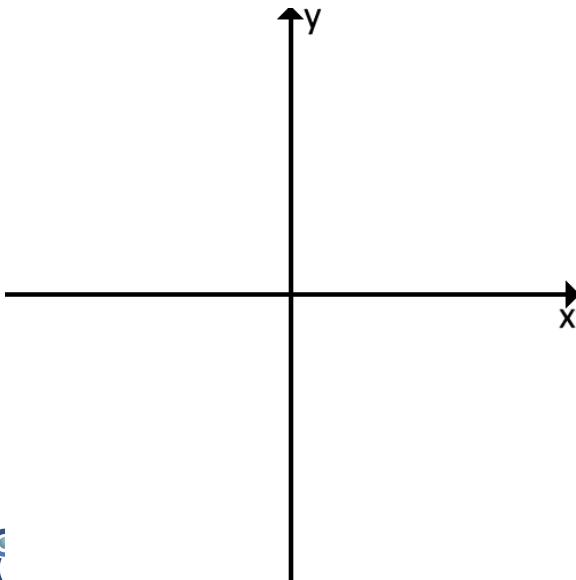


Agnostic Goal Generator

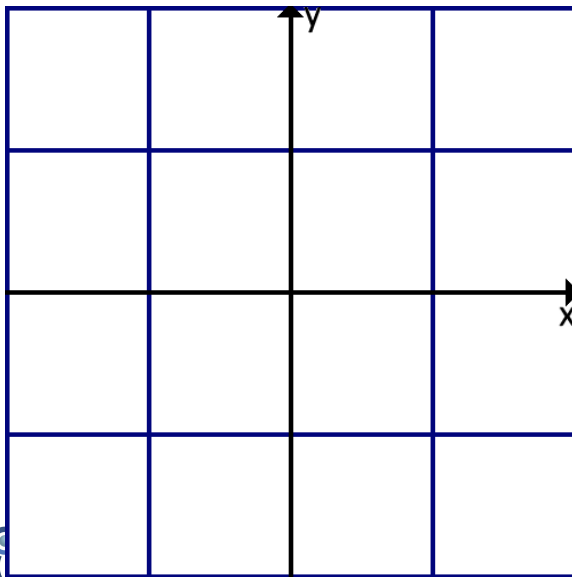


Algorithme Frontier

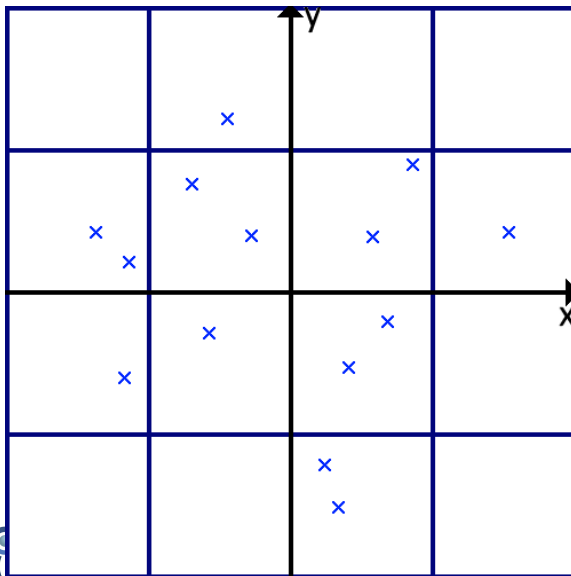
Goals on Grid & Frontier



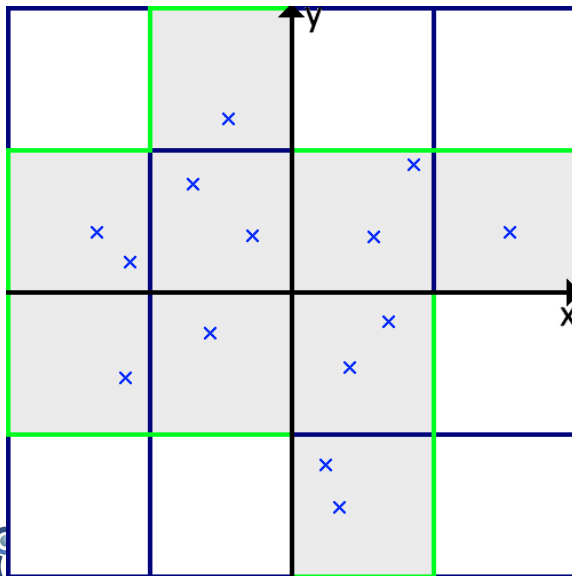
Goals on Grid & Frontier



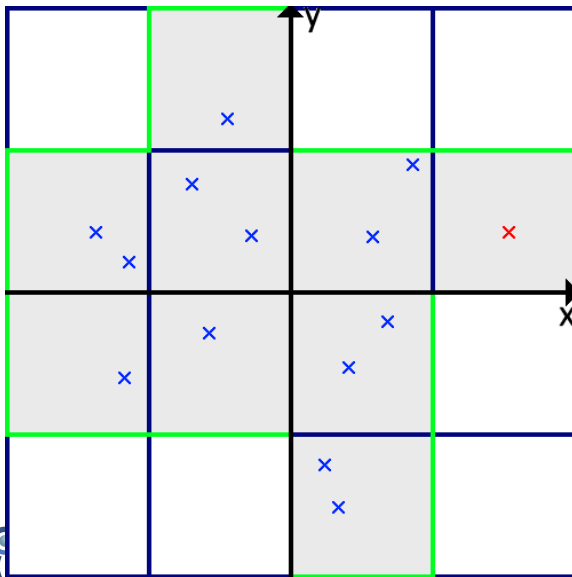
Goals on Grid & Frontier



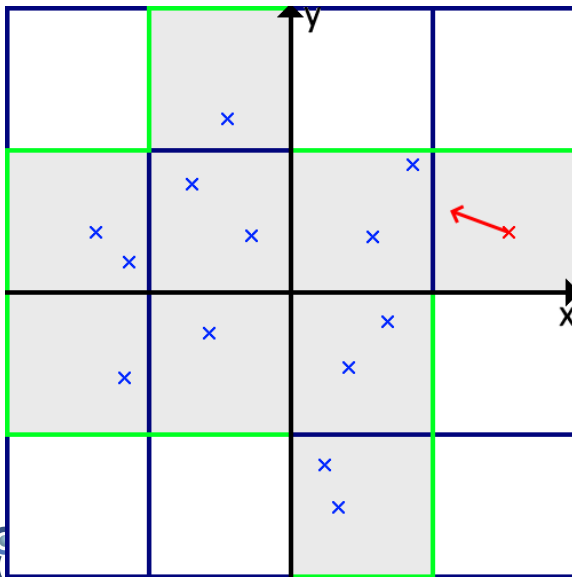
Goals on Grid & Frontier



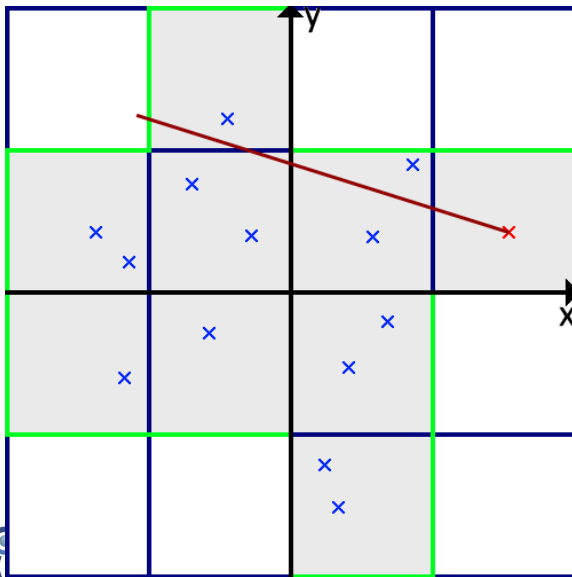
Goals on Grid & Frontier



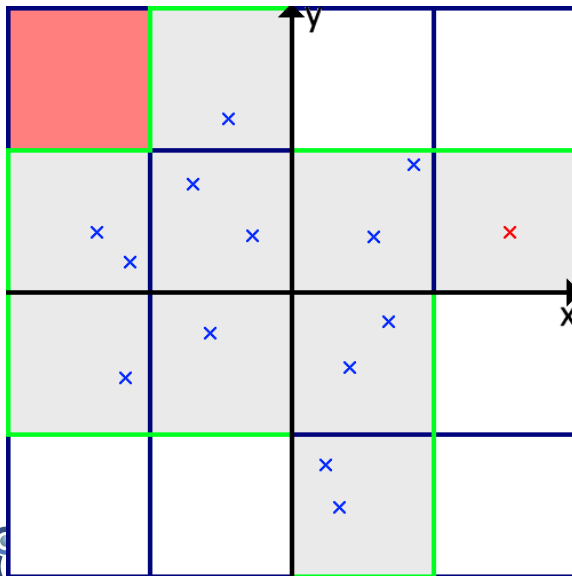
Goals on Grid & Frontier



Goals on Grid & Frontier



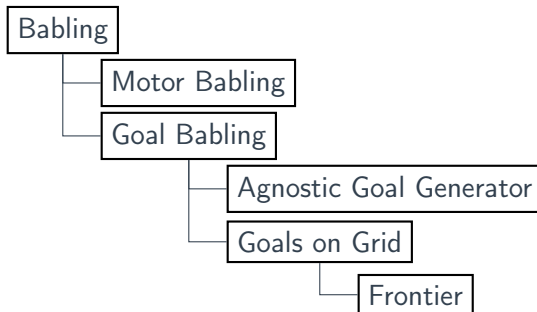
Goals on Grid & Frontier



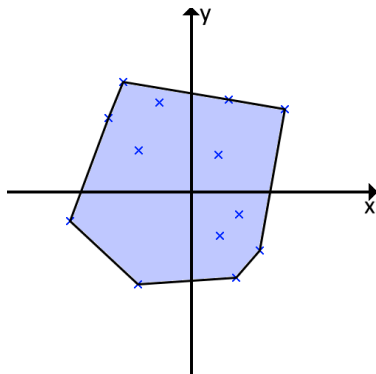
Expérimentation

Expérience

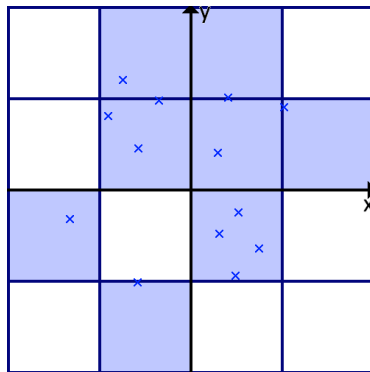
Choisir paramètres \Rightarrow Lancer apprentissage \Rightarrow Mesurer résultat



Couverture : Volume et Remplissage



Enveloppe Convexe

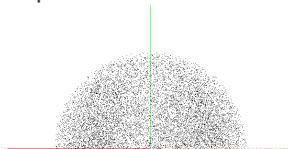


Cellules visitées

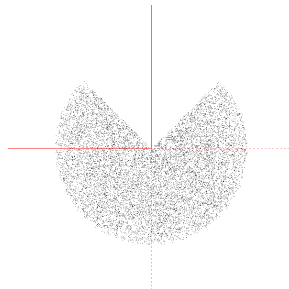
Précision : Erreur sur une liste de test

$$\sum_{g \in \text{goals}} \frac{d(g, G(F(g)))}{nb_goals}$$

Représentation de la liste des buts :



Vue de face

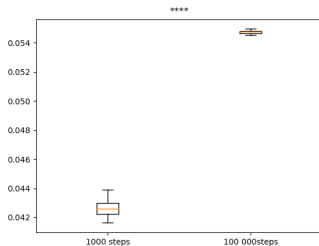


Vue du dessus

Résultats : Motor Babling

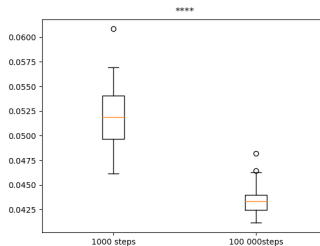
Paramètre p analysé : Nombre d'entrée dans le catalogue

Couverture (volume)



$p \nearrow = \text{Couverture} \nearrow$

Précision (distance liste ikpy)

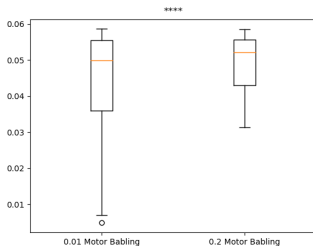


$p \nearrow = \text{Précision} \nearrow$

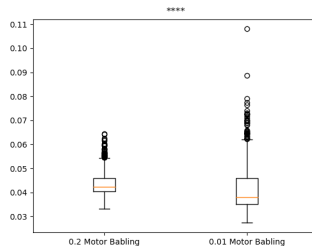
Résultats : Goal Babling

Paramètre p analysé : Proportion de Motor Babling à l'initialisation

Couverture (volume)



Précision (distance liste ikpy)



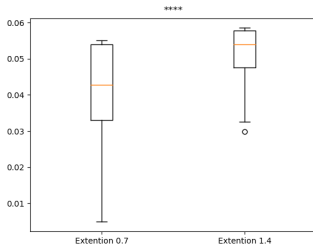
$p \nearrow = \text{Variance Couverture} \searrow$

$p \nearrow = \text{Variance Précision} \nearrow$

Résultats : Agnostic Goal Generator

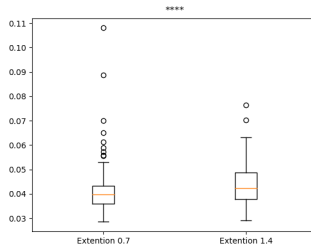
Paramètre p analysé : Taux d'extension de la zone des buts

Couverture (volume)



$p \nearrow$ = Couverture 

Précision (distance liste ikpy)

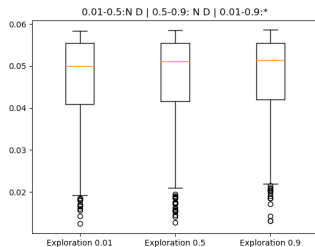


$p \nearrow$ = Précision 

Résultats : Frontier

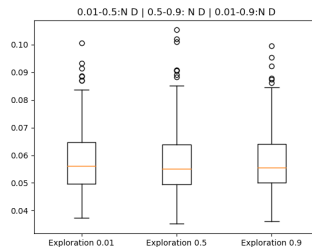
Paramètre p analysé : Probabilité d'exploration

Couverture (volume)



$p \nearrow = \text{Couverture} \rightarrow$

Précision (distance liste ikpy)

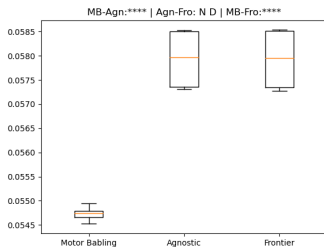


$p \nearrow = \text{Précision} \rightarrow$

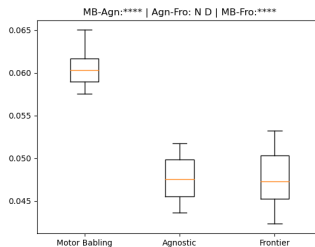
Résultats

Comparaison des 3 algorithmes

Couverture (volume)



Précision (distance liste but)



Conclusion

- ▶ Cinématique Inverse pour Poppy Ergo Jr
- ▶ Babling
 - ▶ Motor Babling
 - ▶ Agnostic Goal Generator
 - ▶ Frontier
- ▶ Résultats
 - ▶ Contraintes ignorées
 - ▶ Incompatibilité Poppy Ergo Jr
 - ▶ Meilleur que Motor Babling : aléatoire total

Merci de votre attention
Avez-vous des questions ?



Pierre-Yves Oudeyer and Frederic Kaplan.

What is intrinsic motivation ? a typology of computational approaches.
Frontiers in Neurorobotics, 1 :6, 2009.



A. Baranes and P. Oudeyer.

Intrinsically motivated goal exploration for active motor learning in robots : A case study.

In *2010 IEEE/RSJ International Conference on Intelligent Robots and Systems*, pages 1766–1773, 2010.



M. Rolf, J. J. Steil, and M. Gienger.

Online goal babbling for rapid bootstrapping of inverse models in high dimensions.

In *2011 IEEE International Conference on Development and Learning (ICDL)*, volume 2, pages 1–8, 2011.



L. Jamone, L. Natale, K. Hashimoto, G. Sandini, and A. Takanishi.

Learning task space control through goal directed exploration.

In *2011 IEEE International Conference on Robotics and Biomimetics*, pages 702–708, 2011.