ANPL | Autonomous Navigation and Perception Lab

ICRA2017

Joint Inference & Belief Space Planning methodology for Efficient Inference Update

Elad I. Farhi & Vadim Indelman

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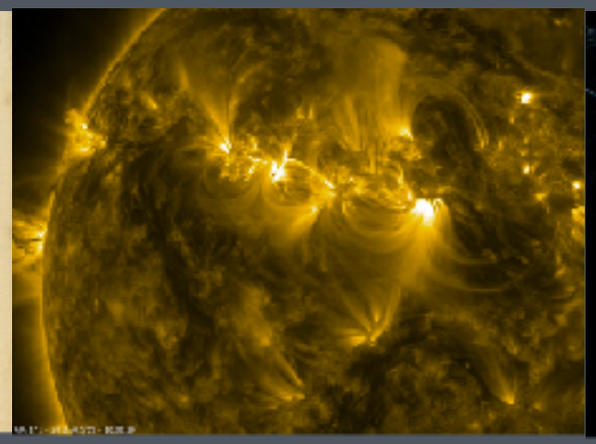
Theories Proven Wrong…

- Earth is not Flat nor is it a perfect Sphere
- Earth is not in the center of our solar system



- The Sun is not really yellow
- Aether has nothing to do with Light, Gravity Drag or Radio

Paradigm Shift

Inference and Planning should not be treated as separate processes

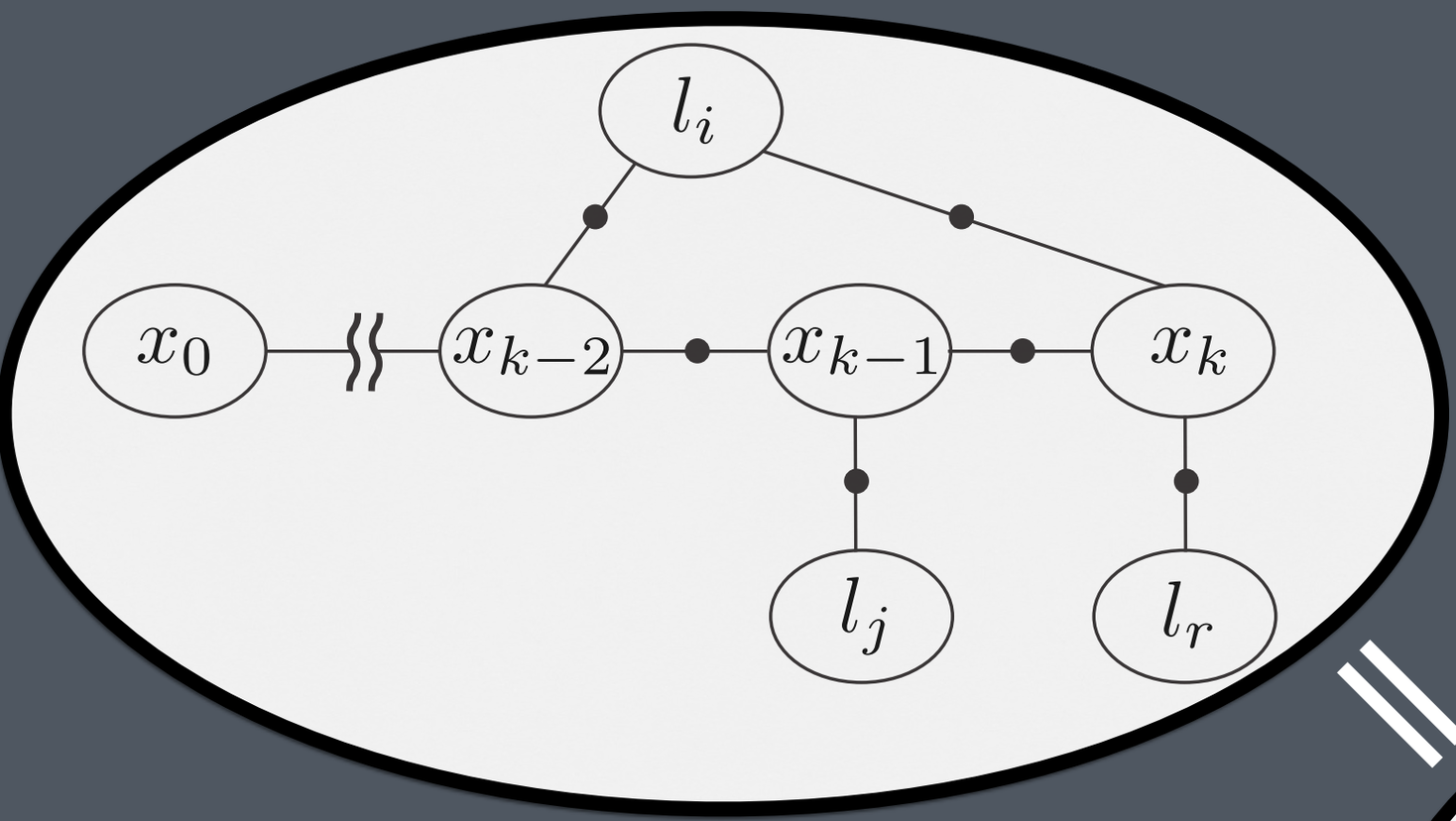
Our Contribution

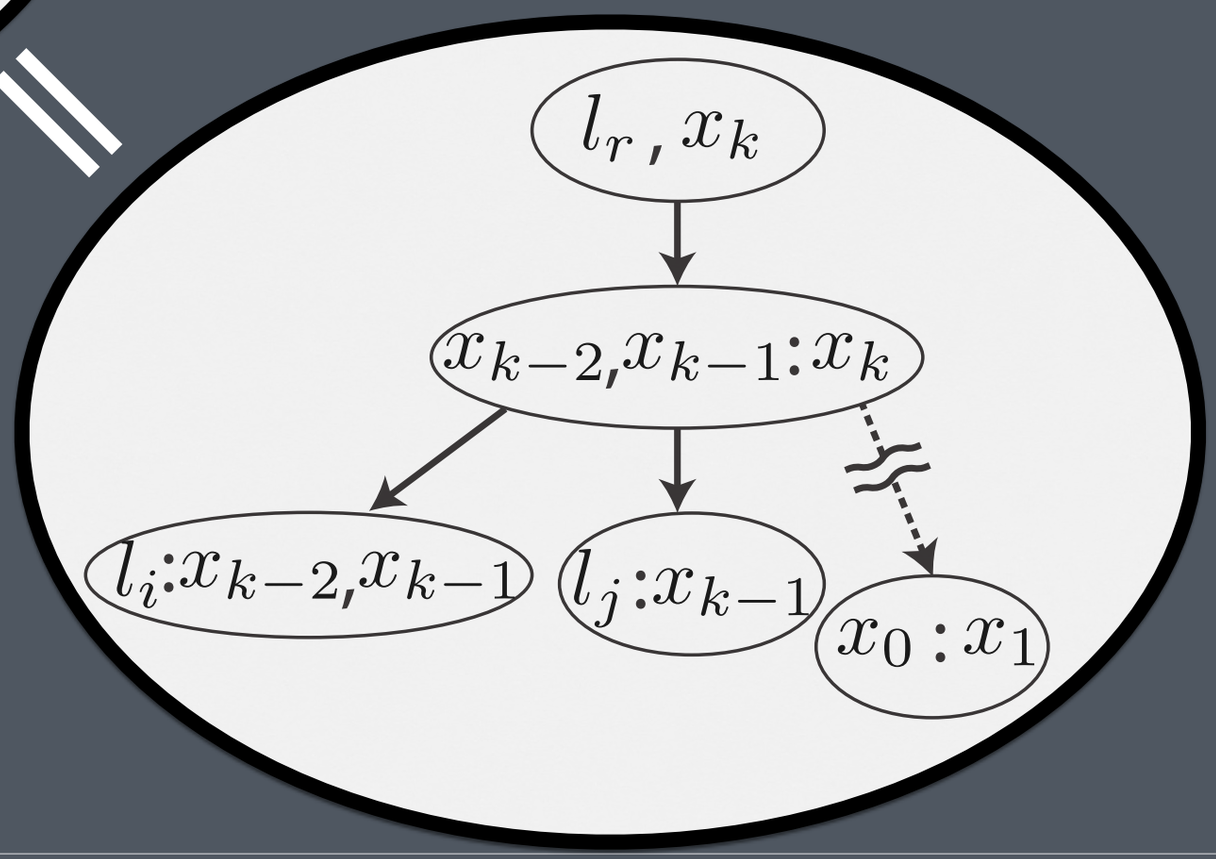
- Inference Update via precursory planning stage
- Presenting JIP - Joint Inference & BSP novel paradigm

Worth Mentioning

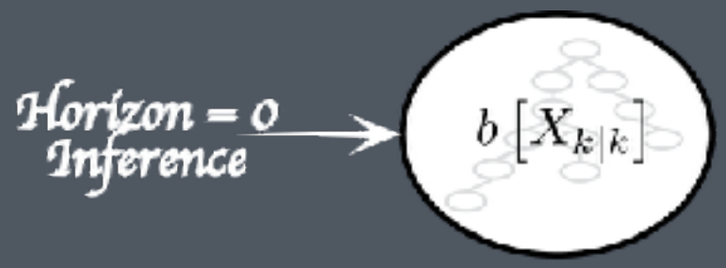
- In this work we assume consistent Data Association
- Our solution provides with the same estimation Accuracy

Belief $b\left[X_{k|k}\right]$ as a Factor Graph or a Bayes Tre



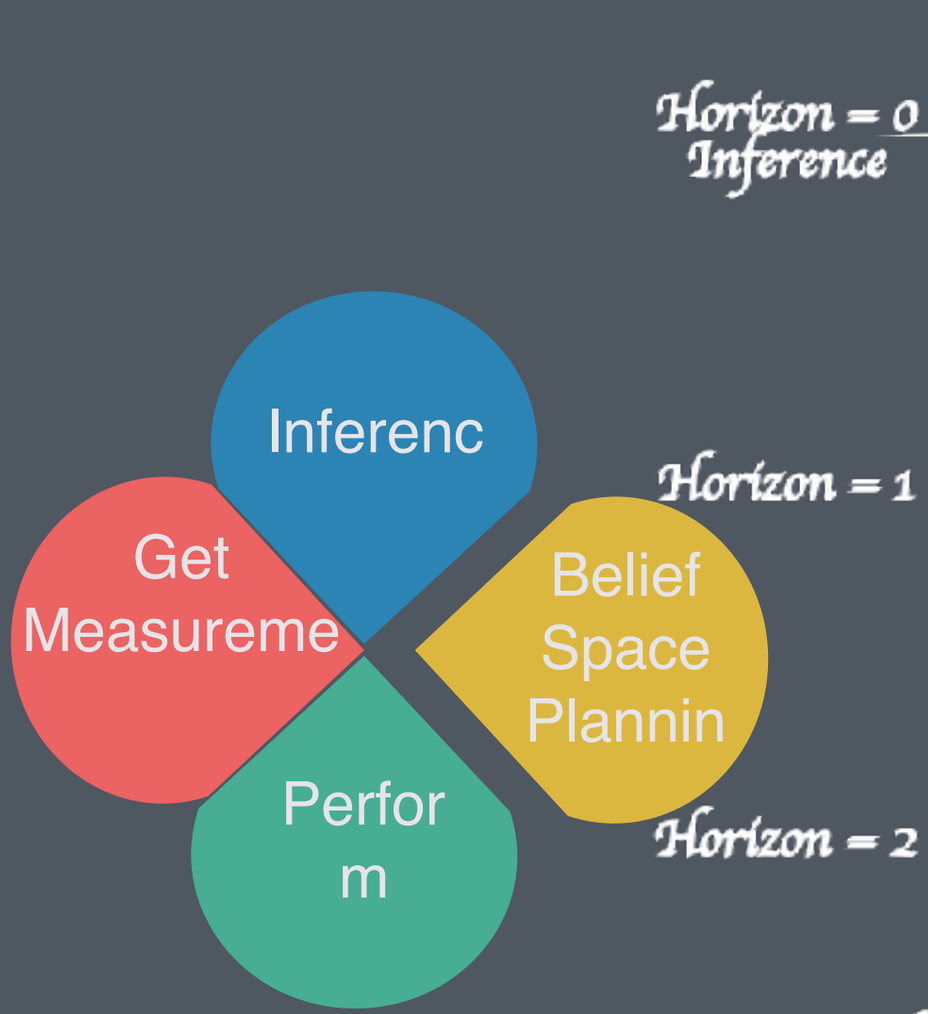


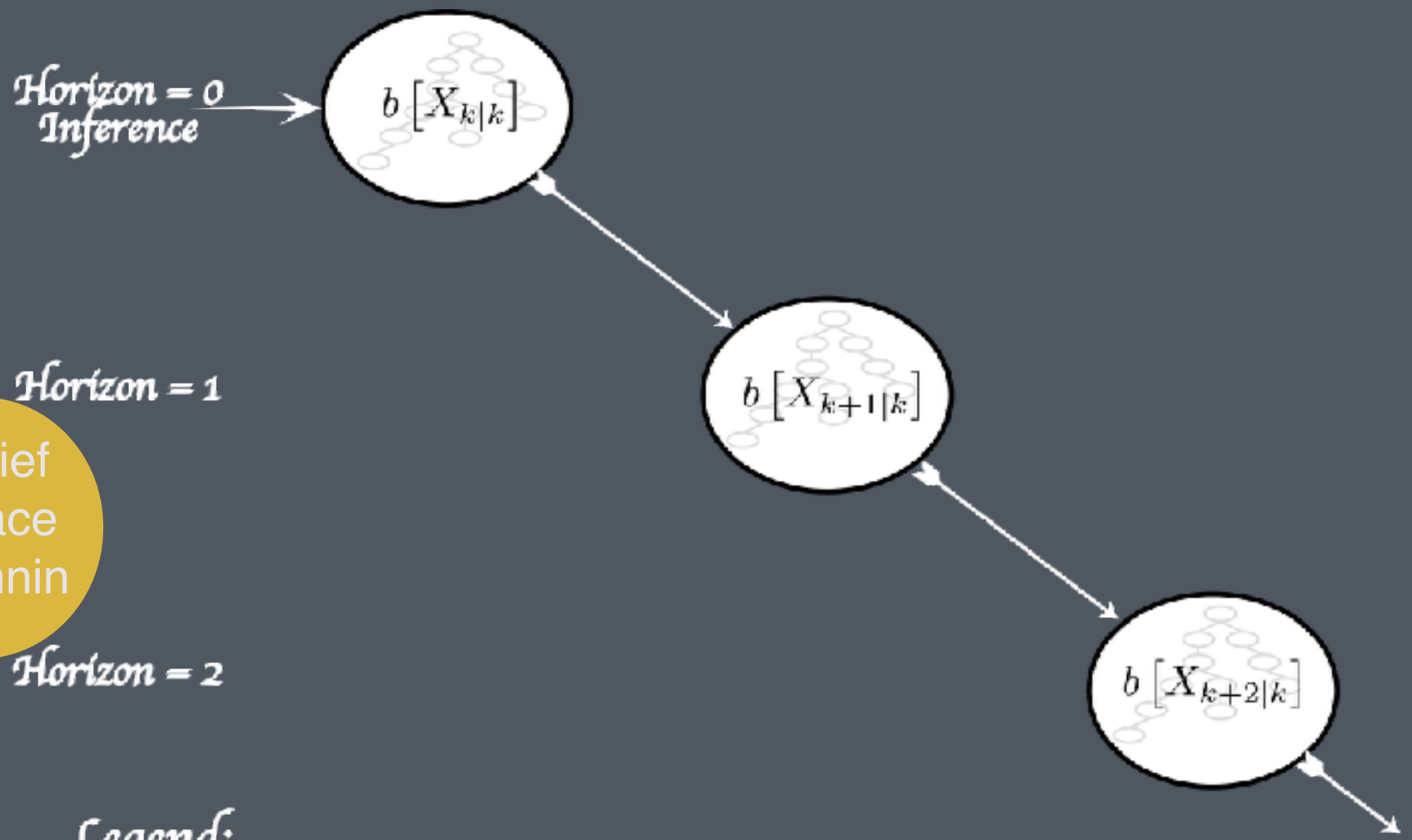
What is Being Done Today



Legend:
(a) → Inference

What is Being Done Today





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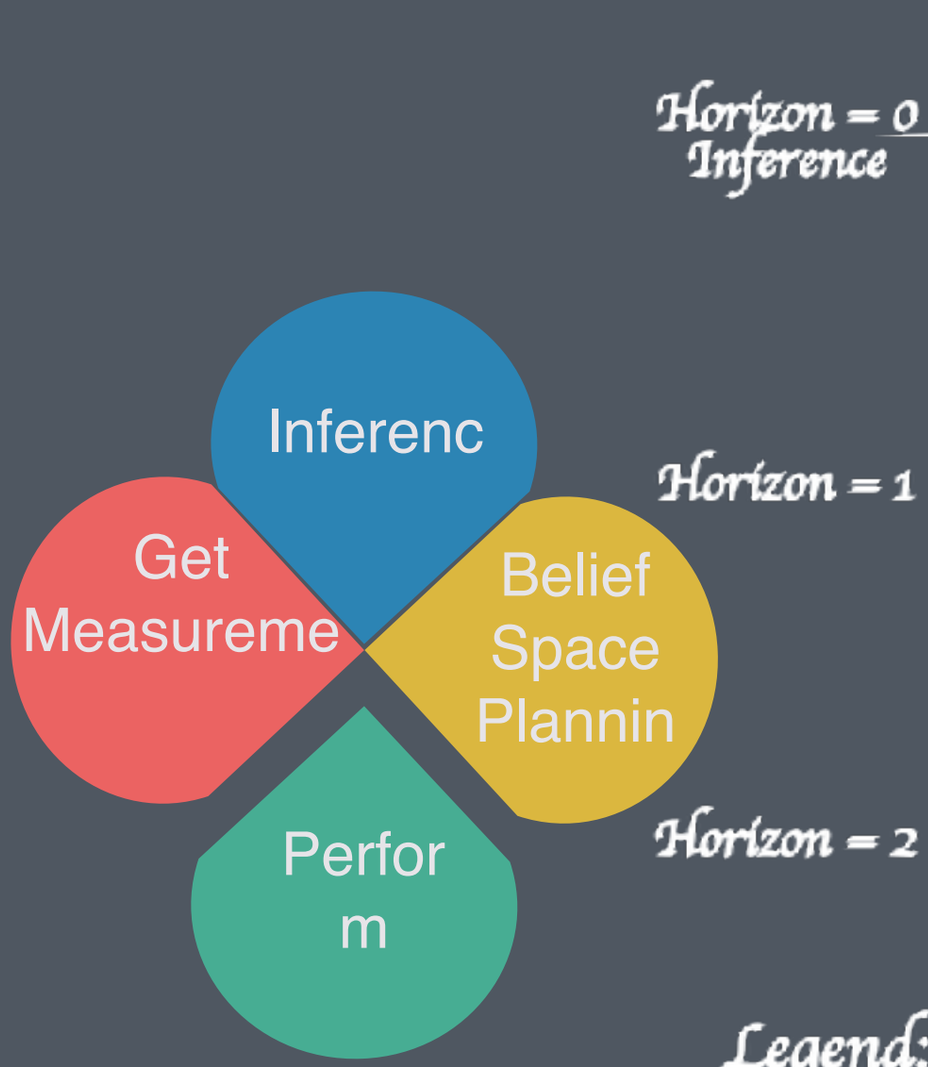


Horizon = 0
Inference

$b\left[X_{k|k}\right]$

Horizon = 1

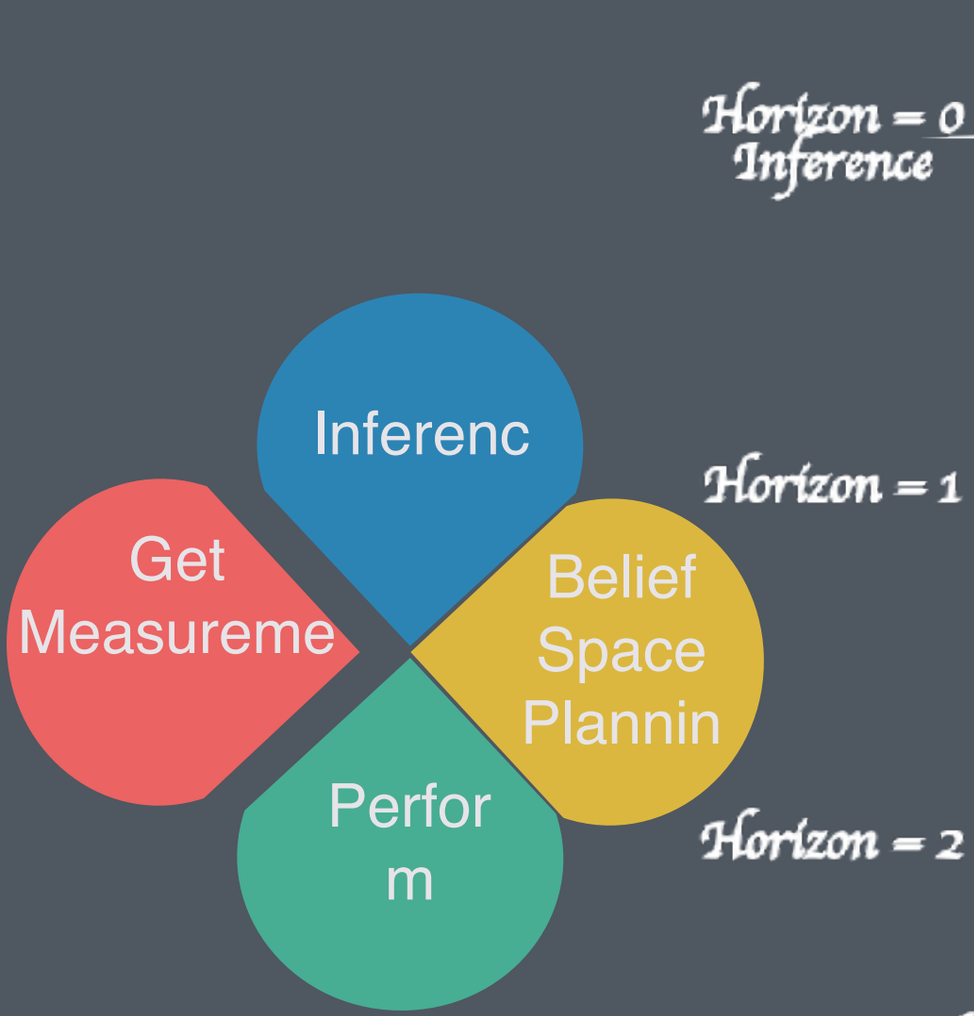
$b\left[X_{k+1|k}\right]$

Horizon = 2

$b\left[X_{k+2|k}\right]$

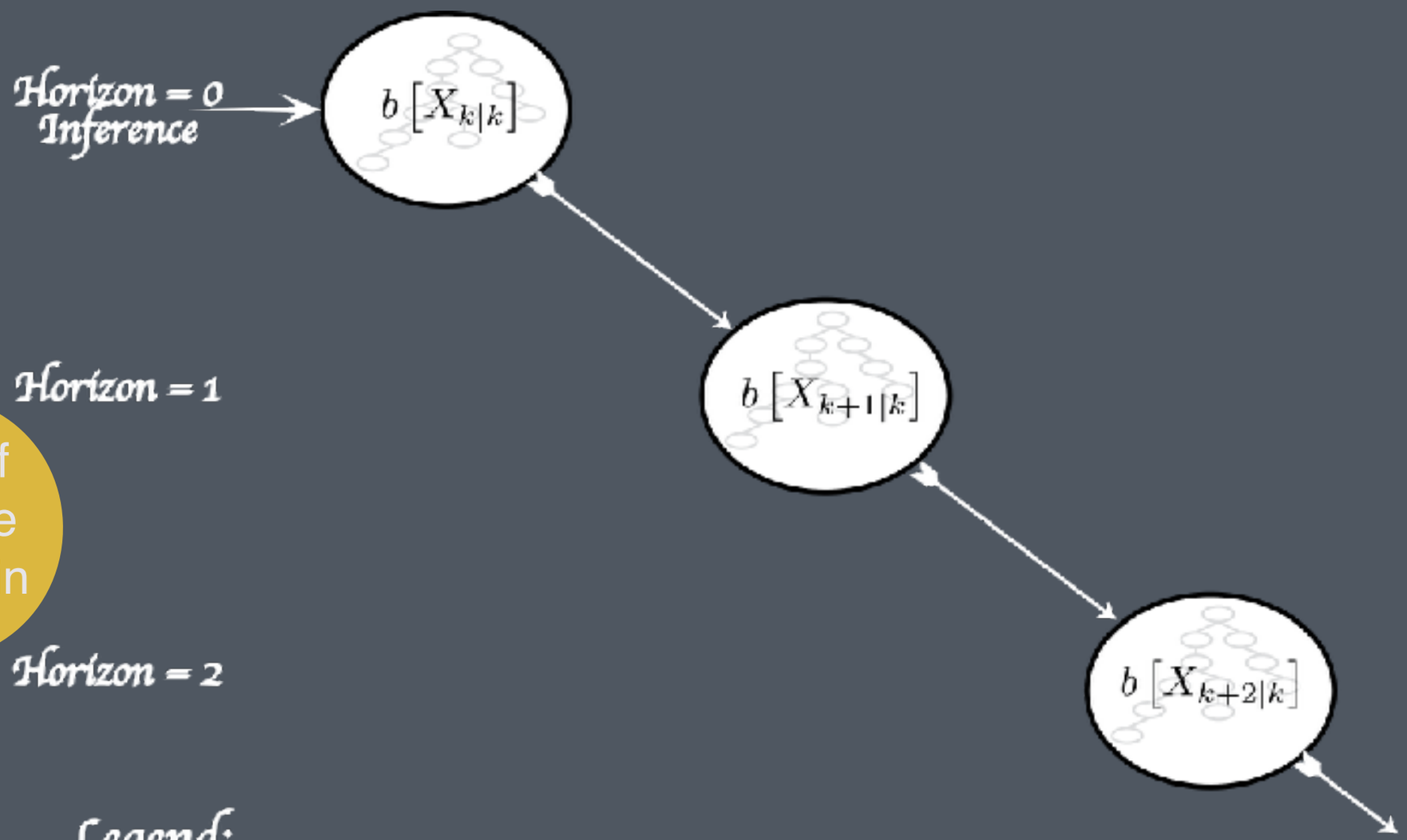
Legend:
(a) → Inference
(b) ↘ Planning

What is Being Done Today



Horizon = 1

Horizon = 2

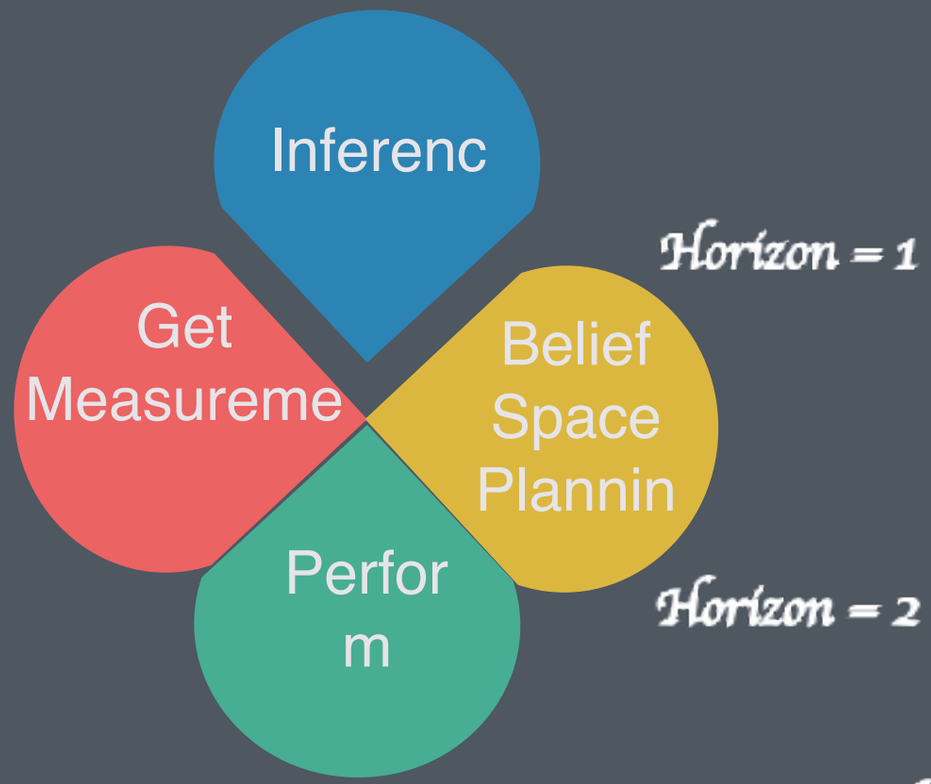


Legend:

(a) → Inference

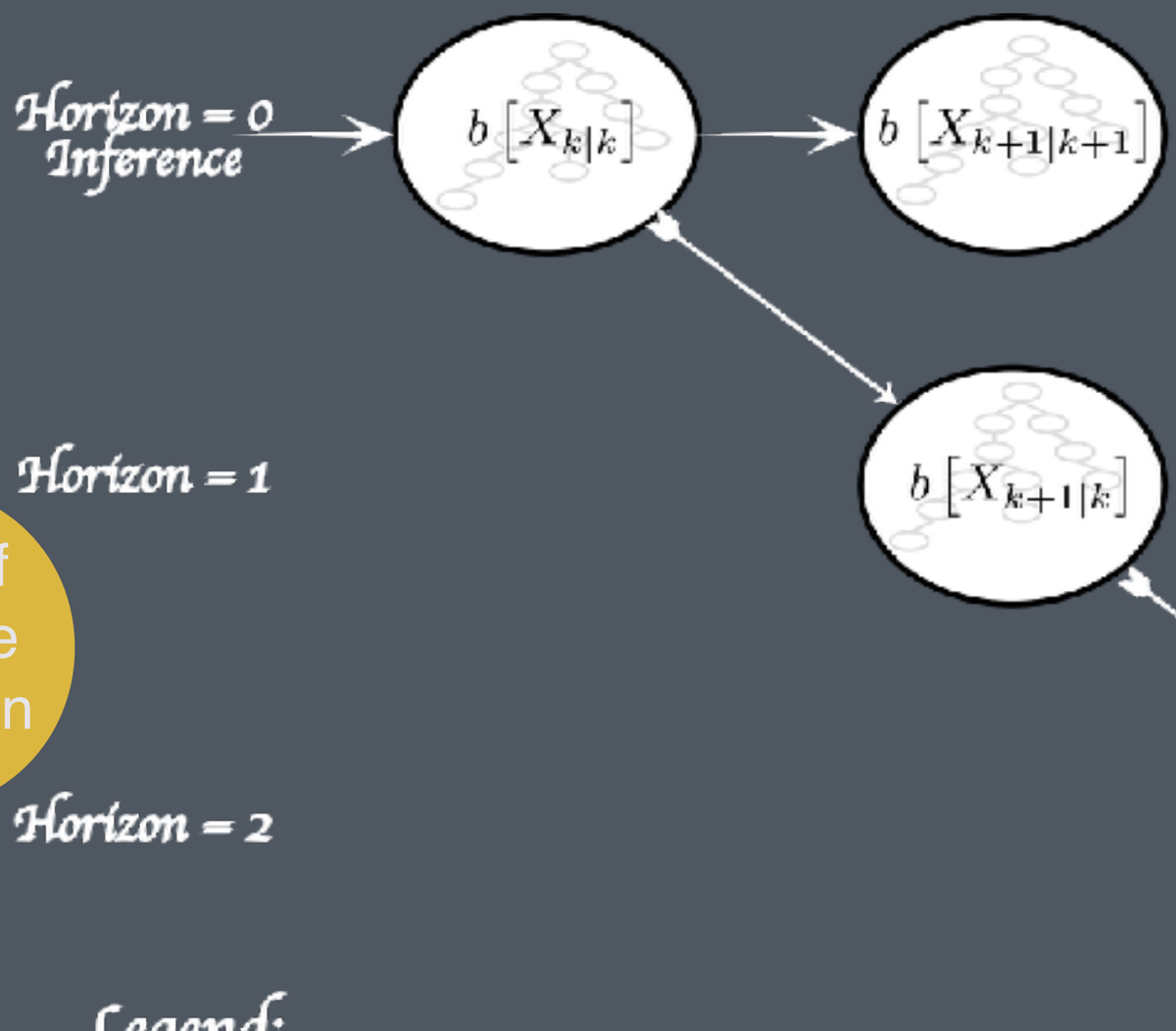
(b) ↘ Planning

Inference Update Today



Horizon = 1

Horizon = 2

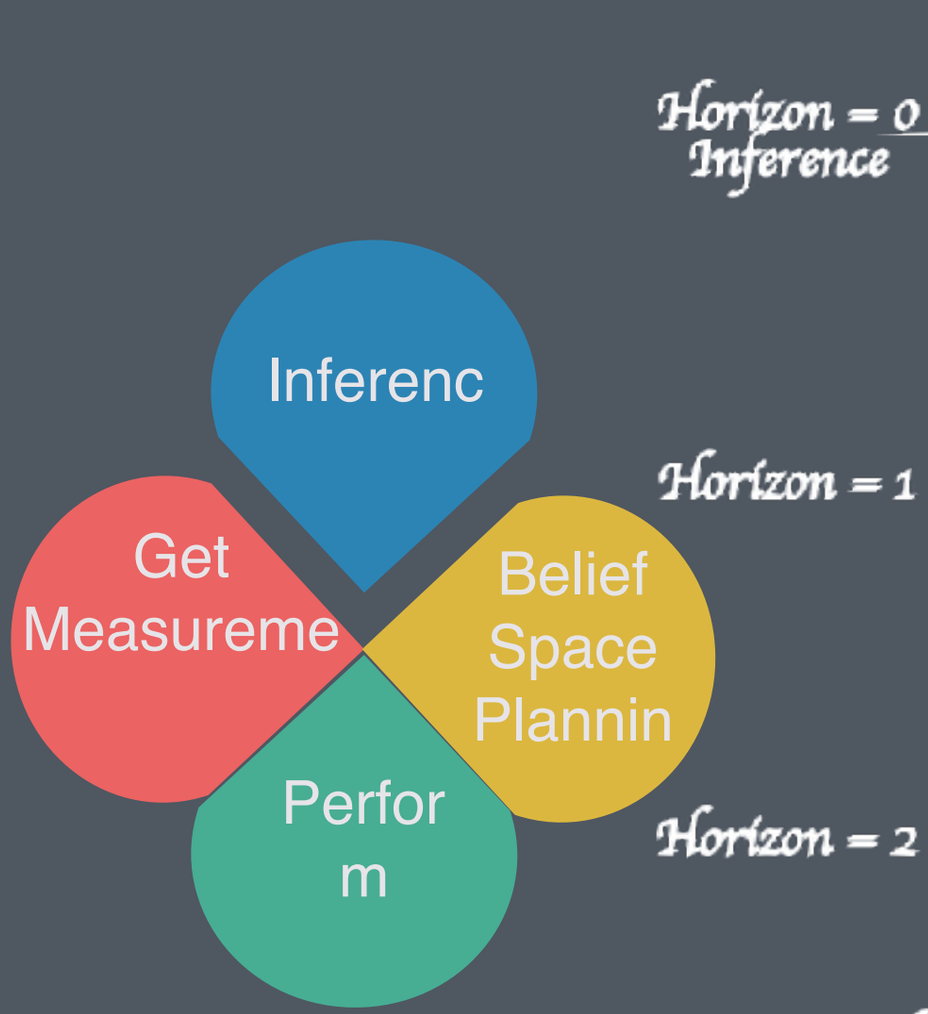


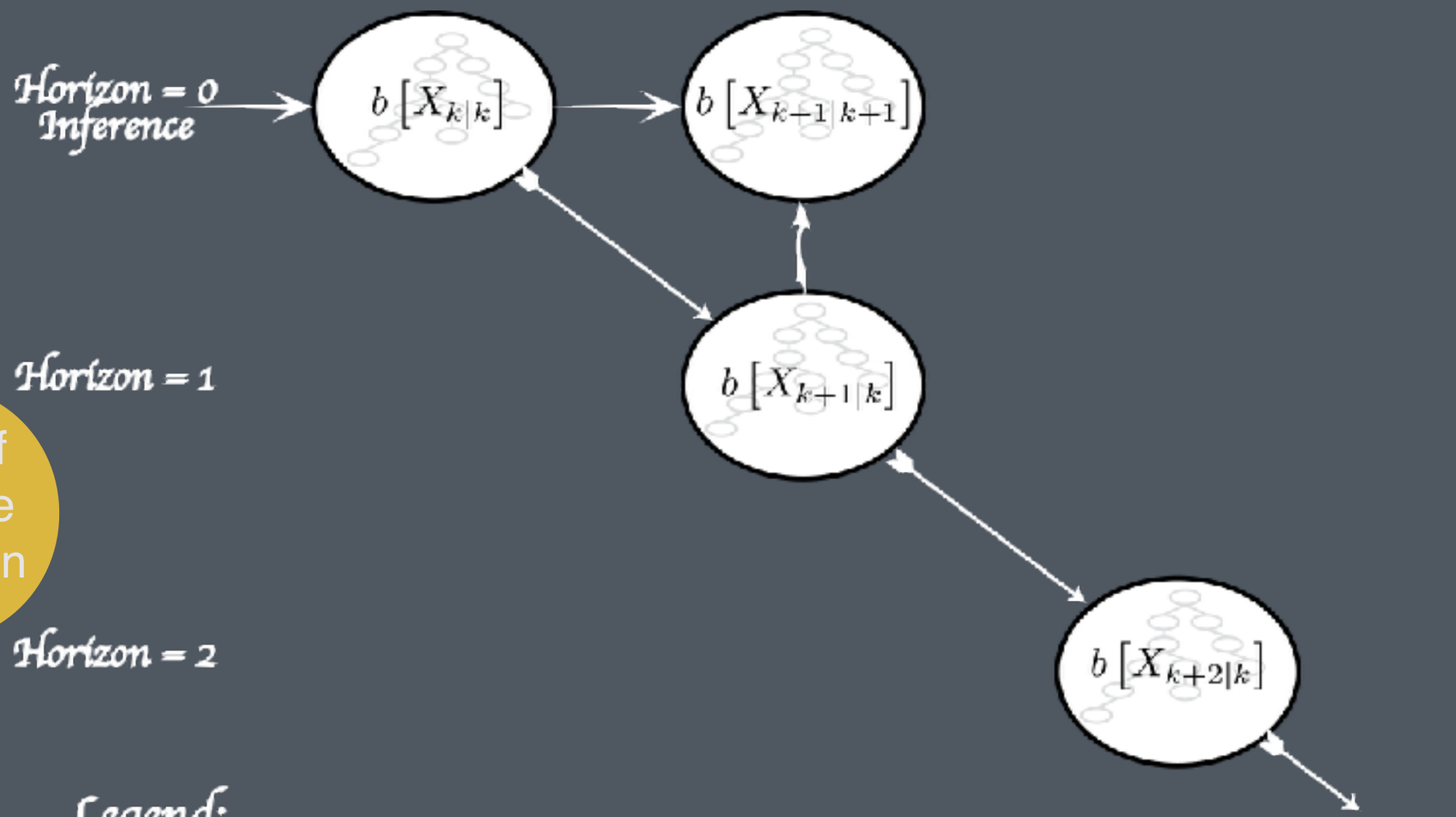
Legend:

(a) → Inference

(b) ↘ Planning

Inference Update via Precursory BSP





Our proposed methods

OTM

Orthogonal Transformation Matrix

DU

Down-date Update

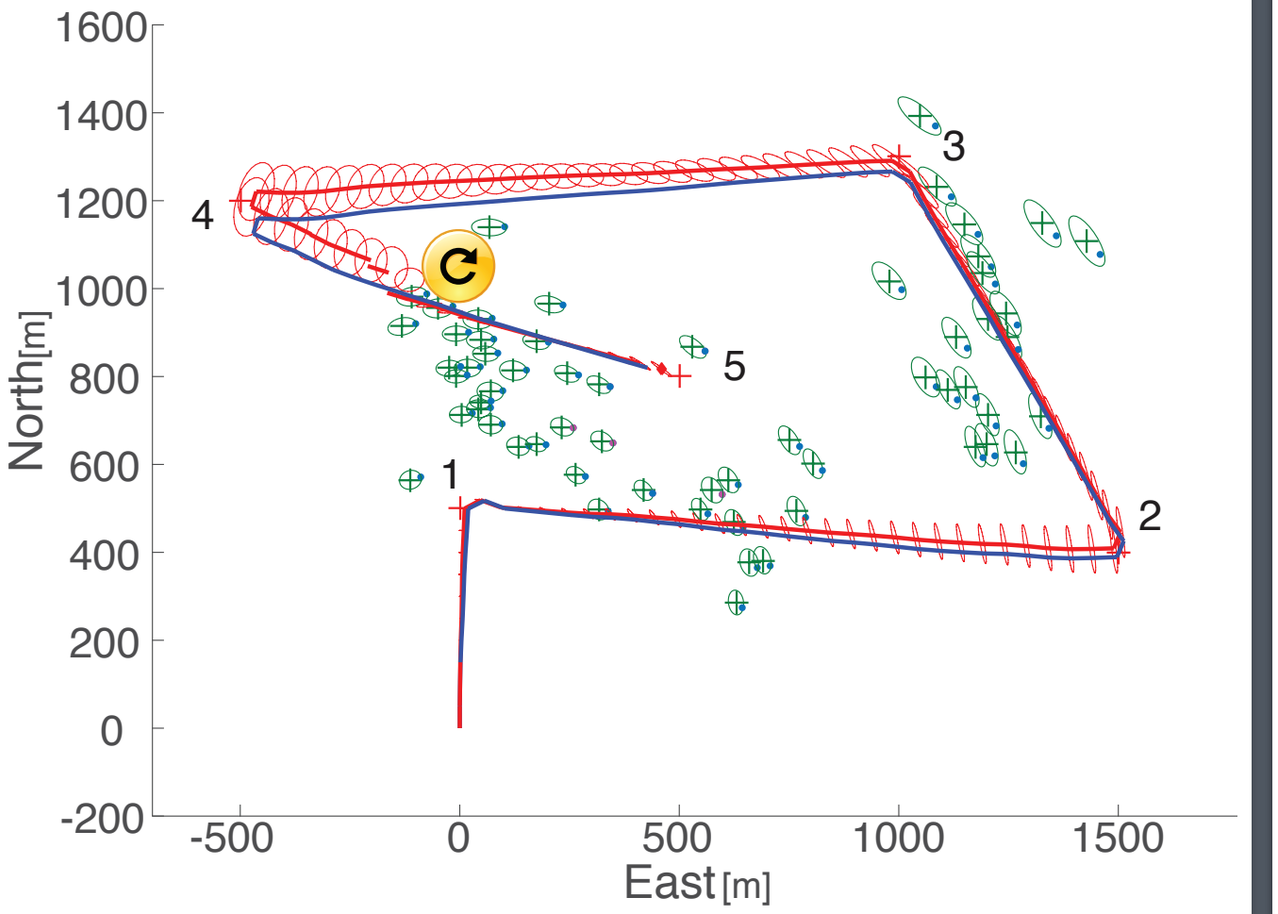
OTM-OO

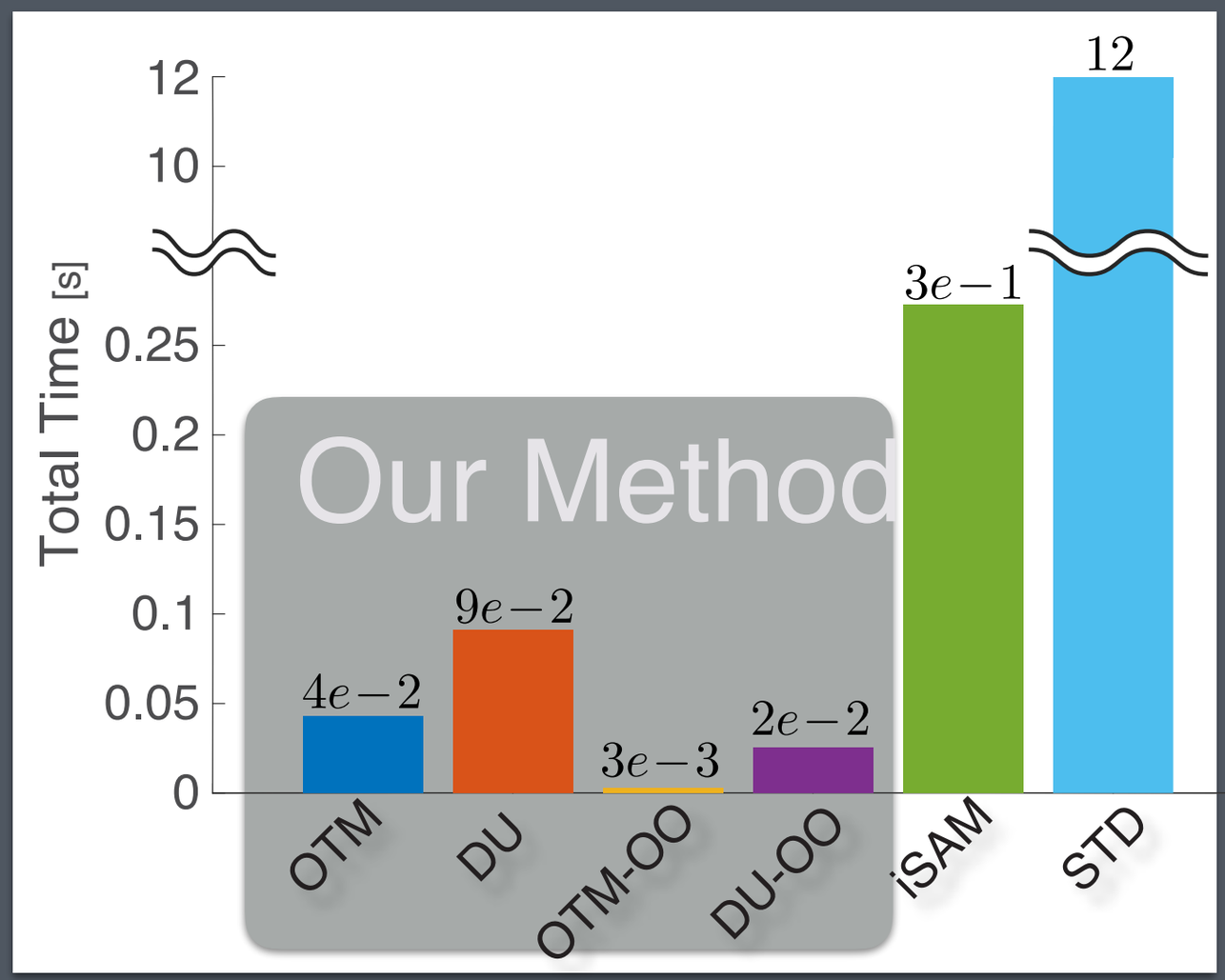
OTM - Only Observation

DU-OO

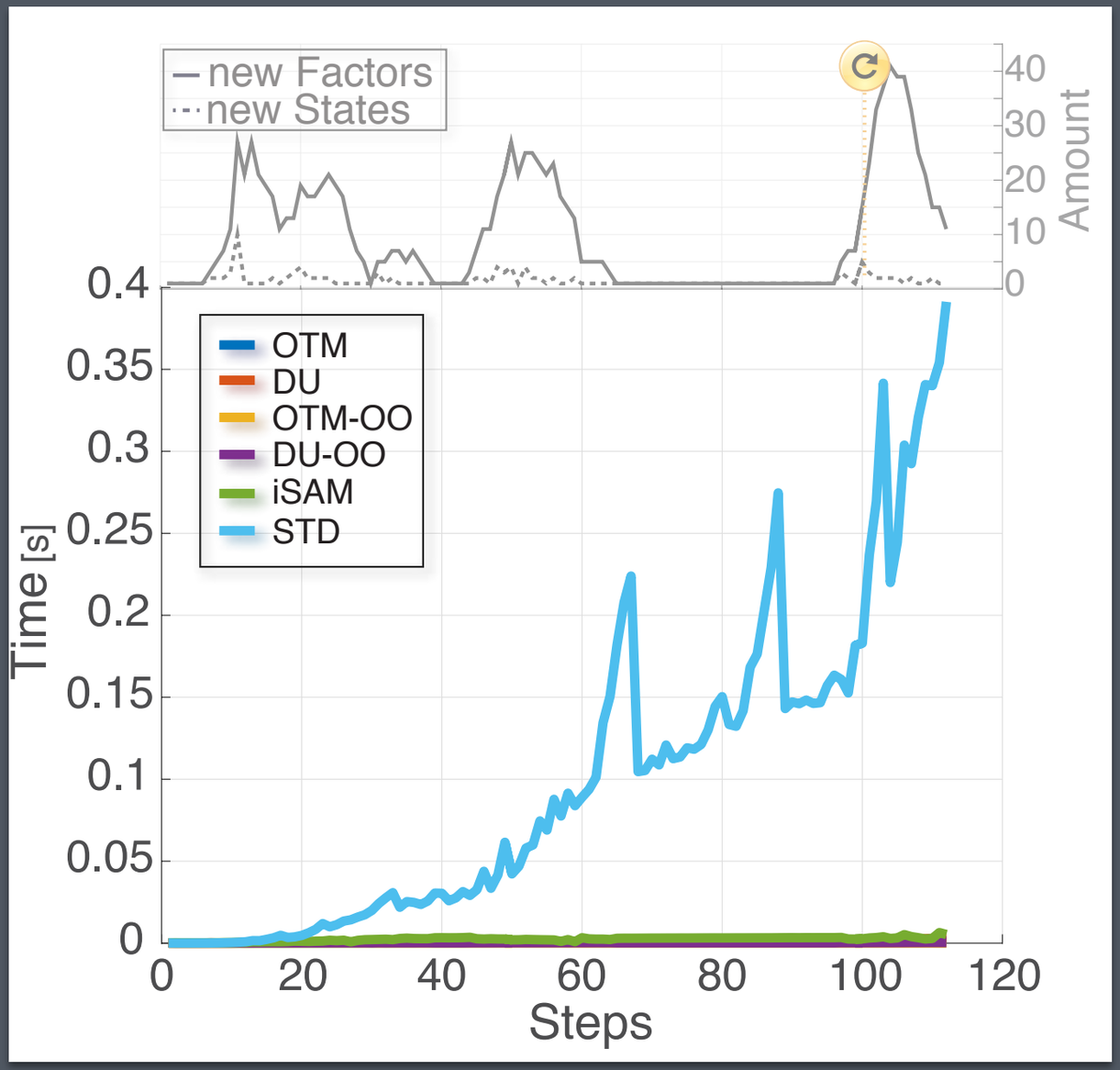
DU - Only Observatio

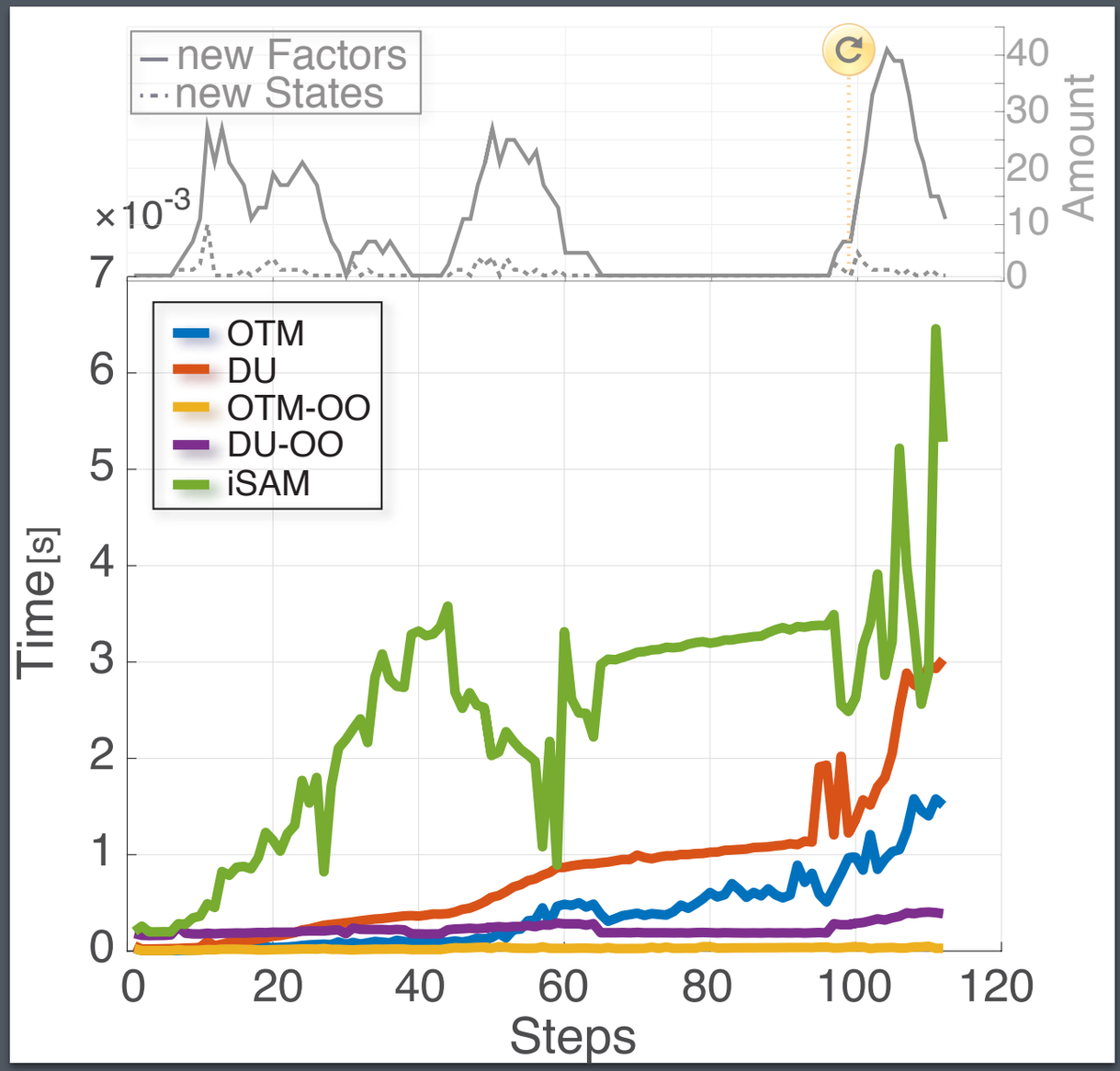
Inference Update - Total Time Comparison





Performance Per-step





Summing Up

- Paradigm Shift - Efficient inference update is viable using calculations from precursory planning
- We provided four different methods that efficiently update inference under consistent DA assumption.
- Our methods, in particular OTM-OO, are faster by orders of magnitude and more robust to state dimensionality and loop closures
- We presented JIP novel approach for joint inference and belief space planning paradigm

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Q & A Session

Thanks for Listening
Looking forward to answer your questions

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