

# Joint Inference & Belief Space Planning methodology for Efficient Inference Update

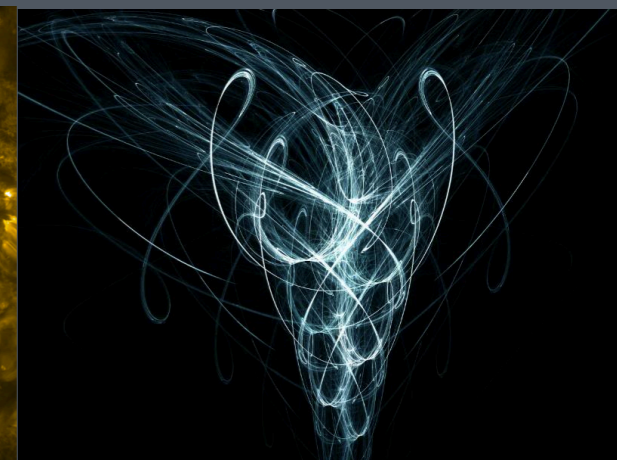
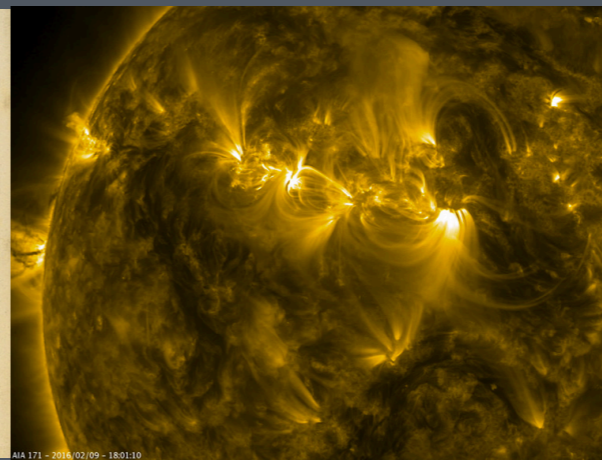
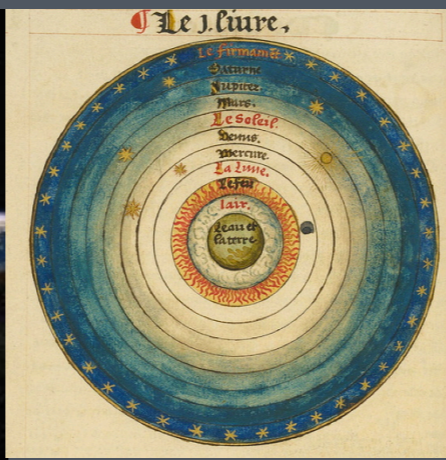


E l a d I . F a r h i & V a d i m I n d e l m a n

**May 2017**

# 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

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Inference and Planning  
should not be treated as  
separate processes

# Our Contribution

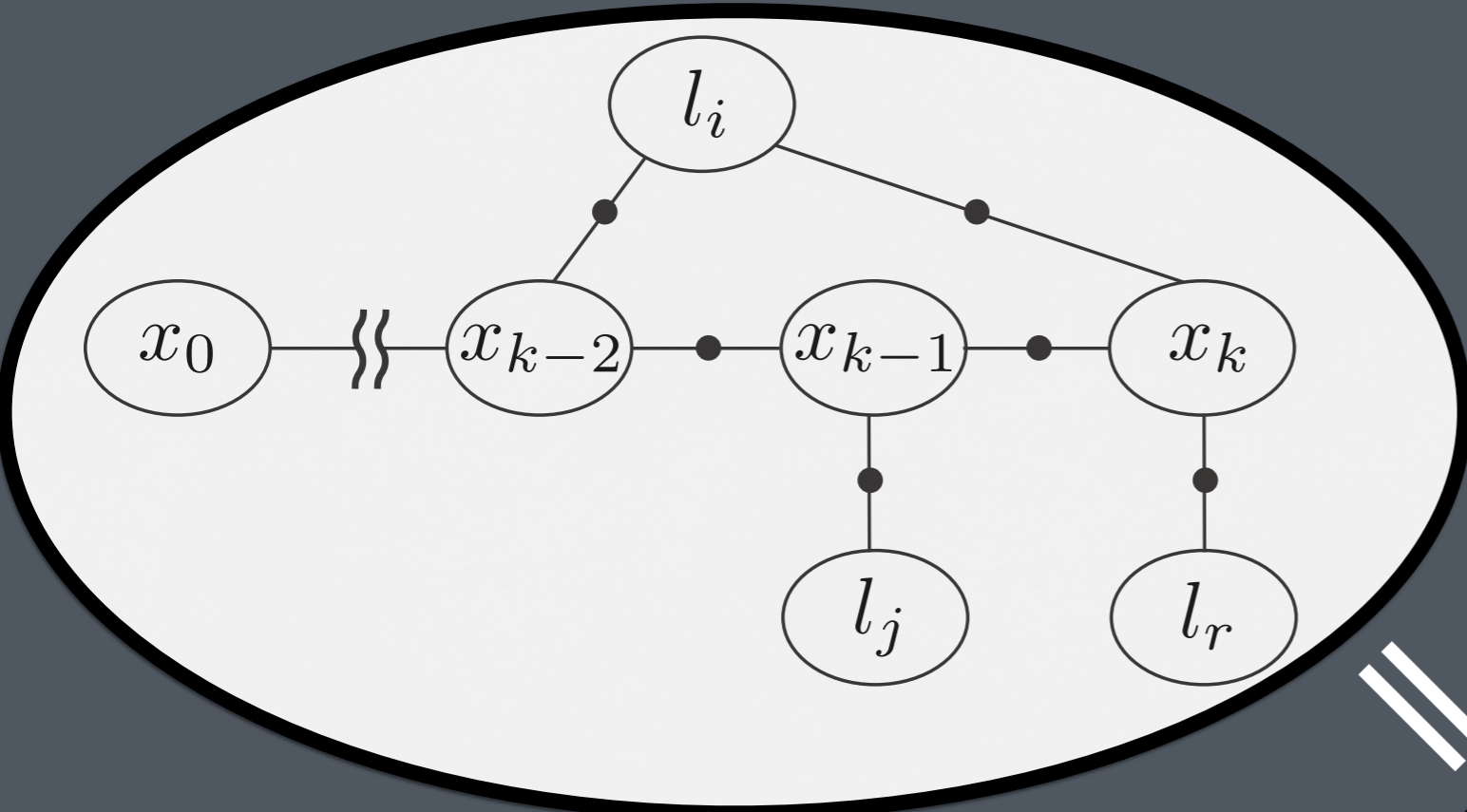
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- Inference Update via precursory planning stage
- Presenting  $JIP$  - Joint Inference & BSP novel paradigm

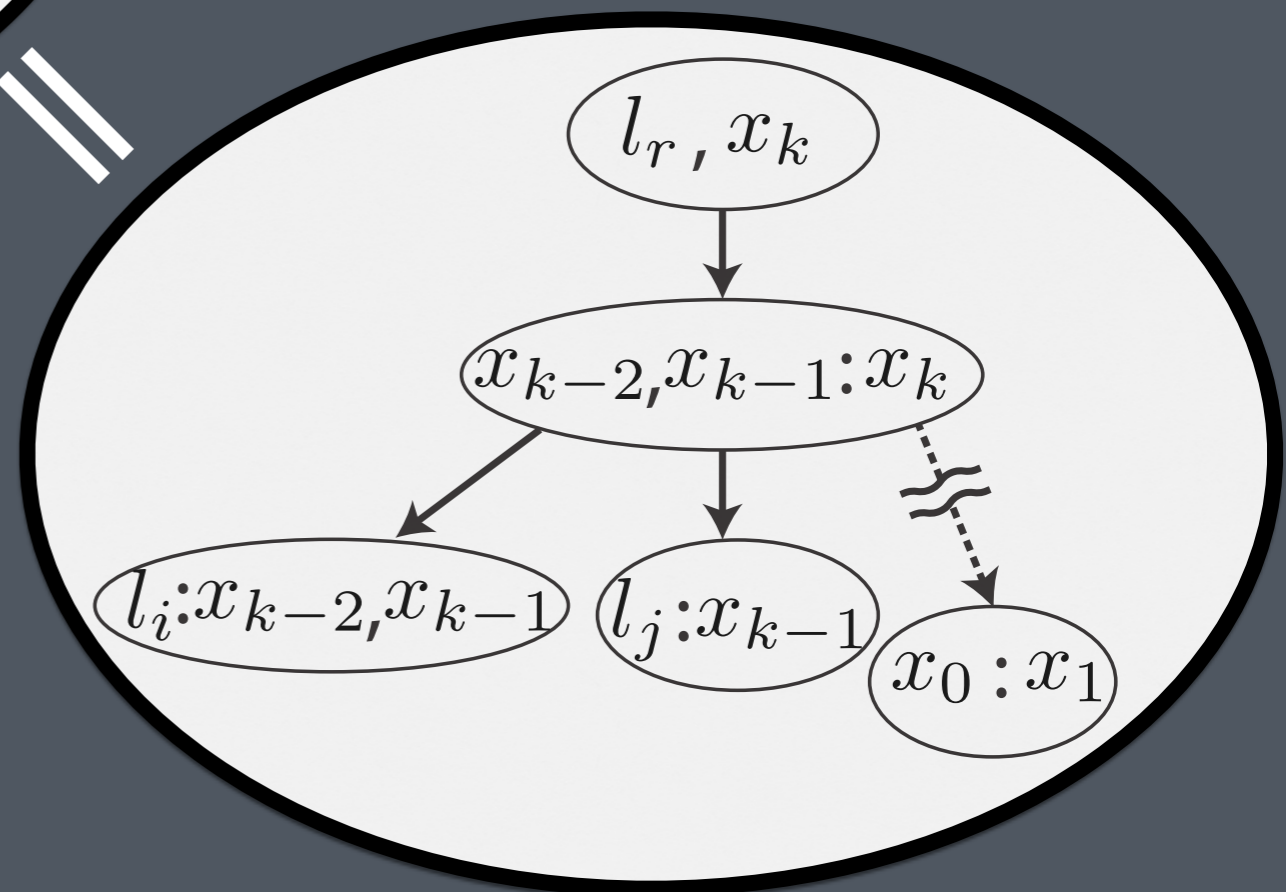
## Worth Mentioning

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

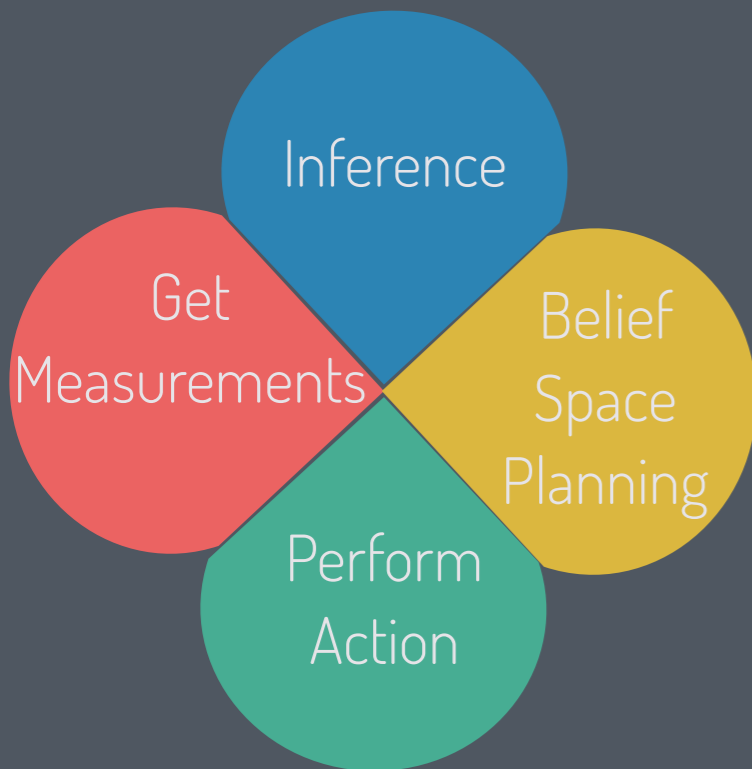
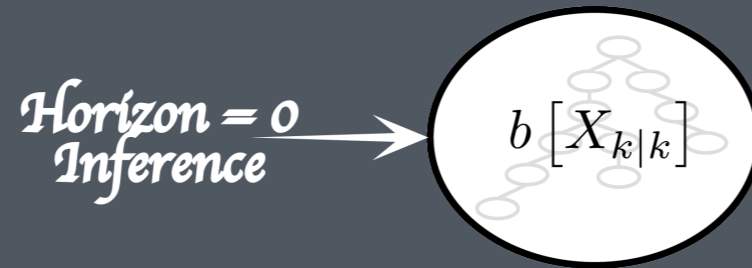
# Belief $b [X_{k|k}]$ as a Factor Graph or a Bayes Tree



=



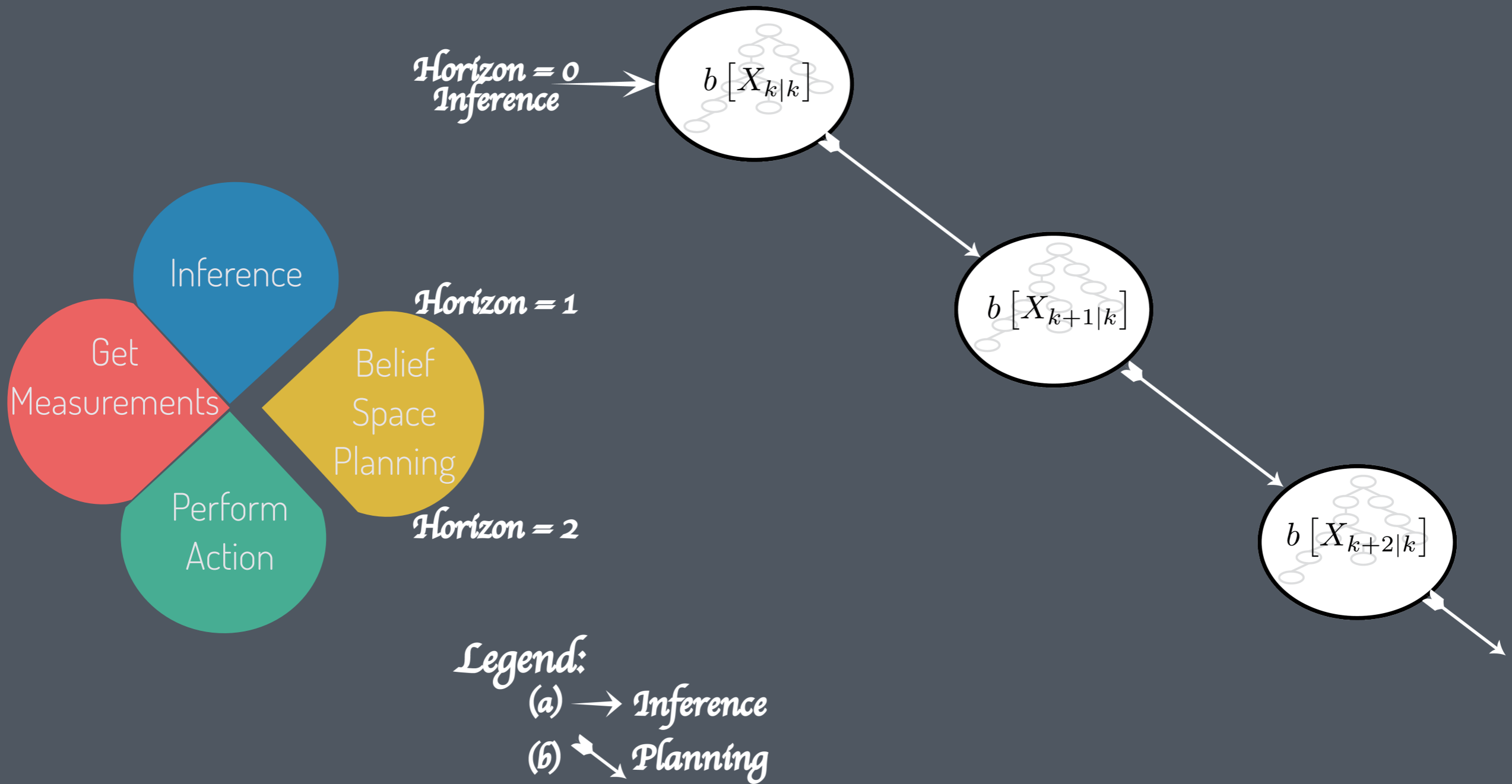
# What is Being Done Today



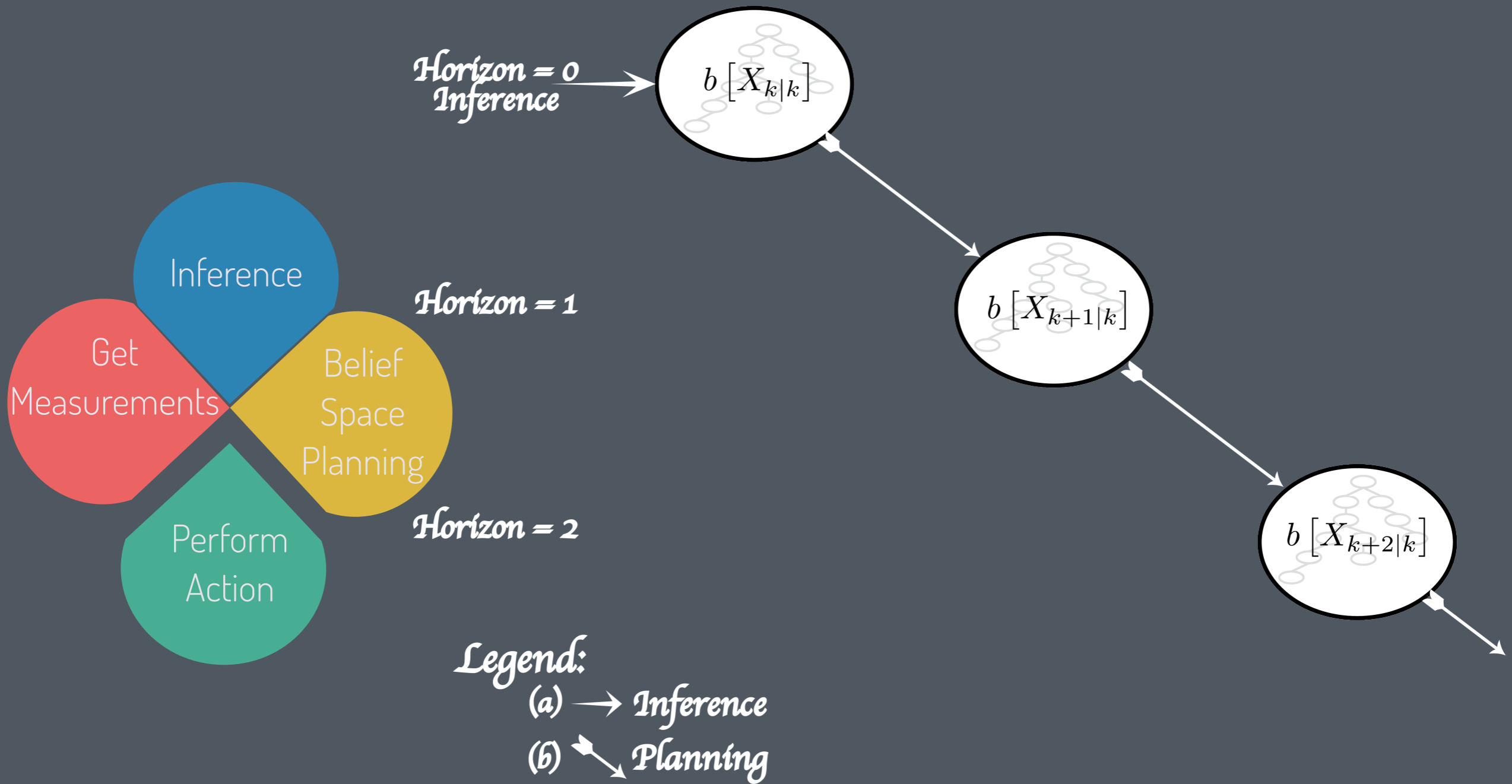
Legend:  
(a) → Inference



# What is Being Done Today

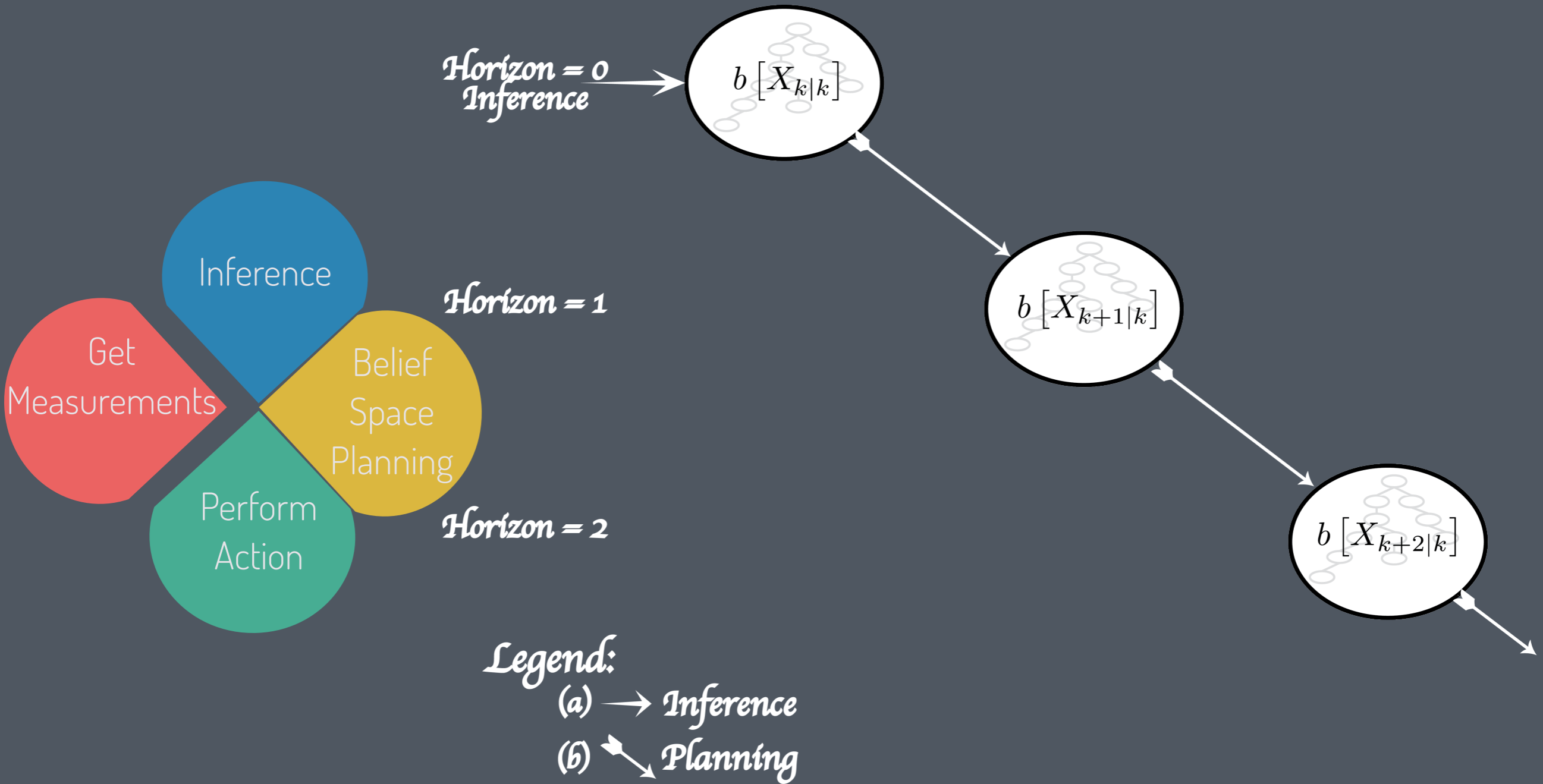


# What is Being Done Today

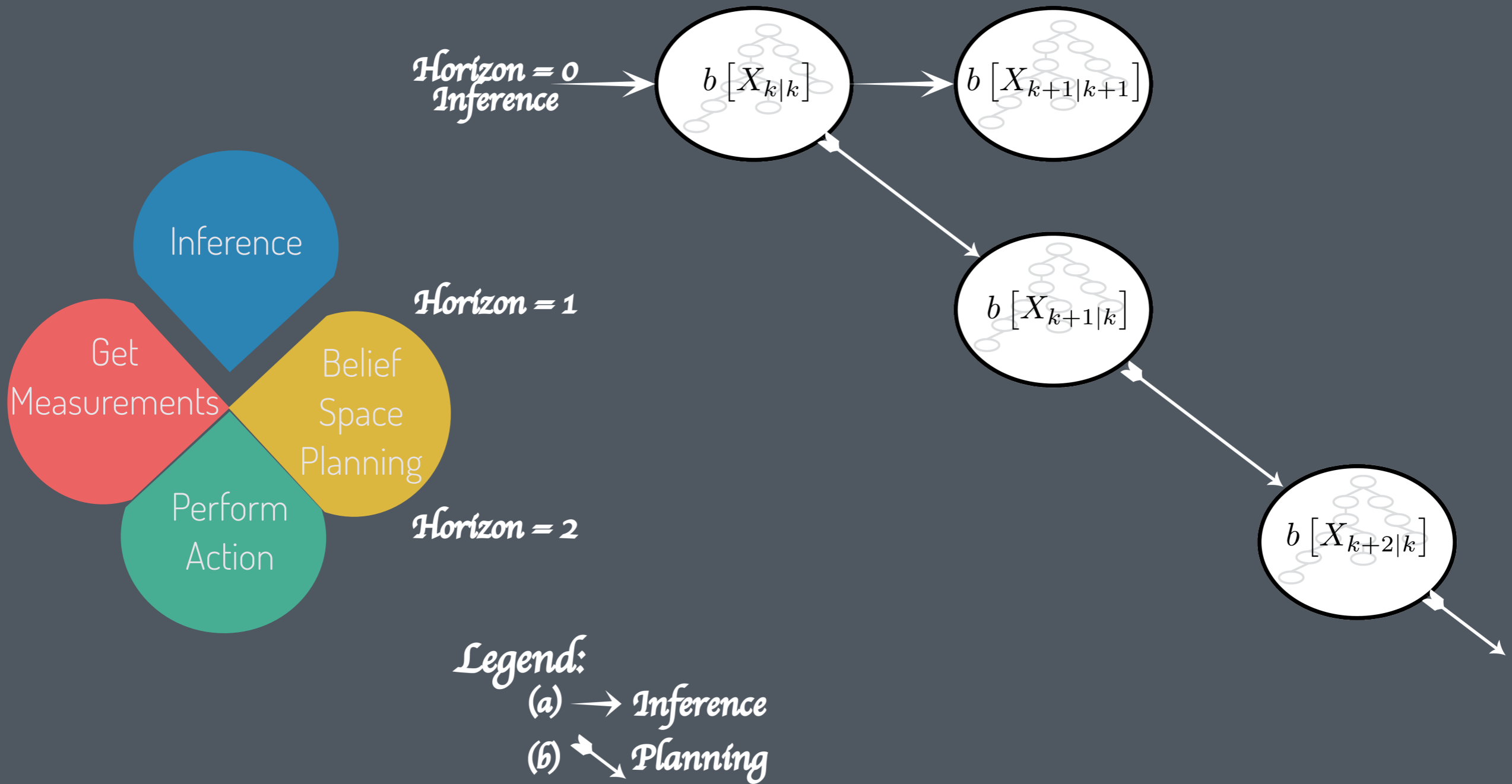




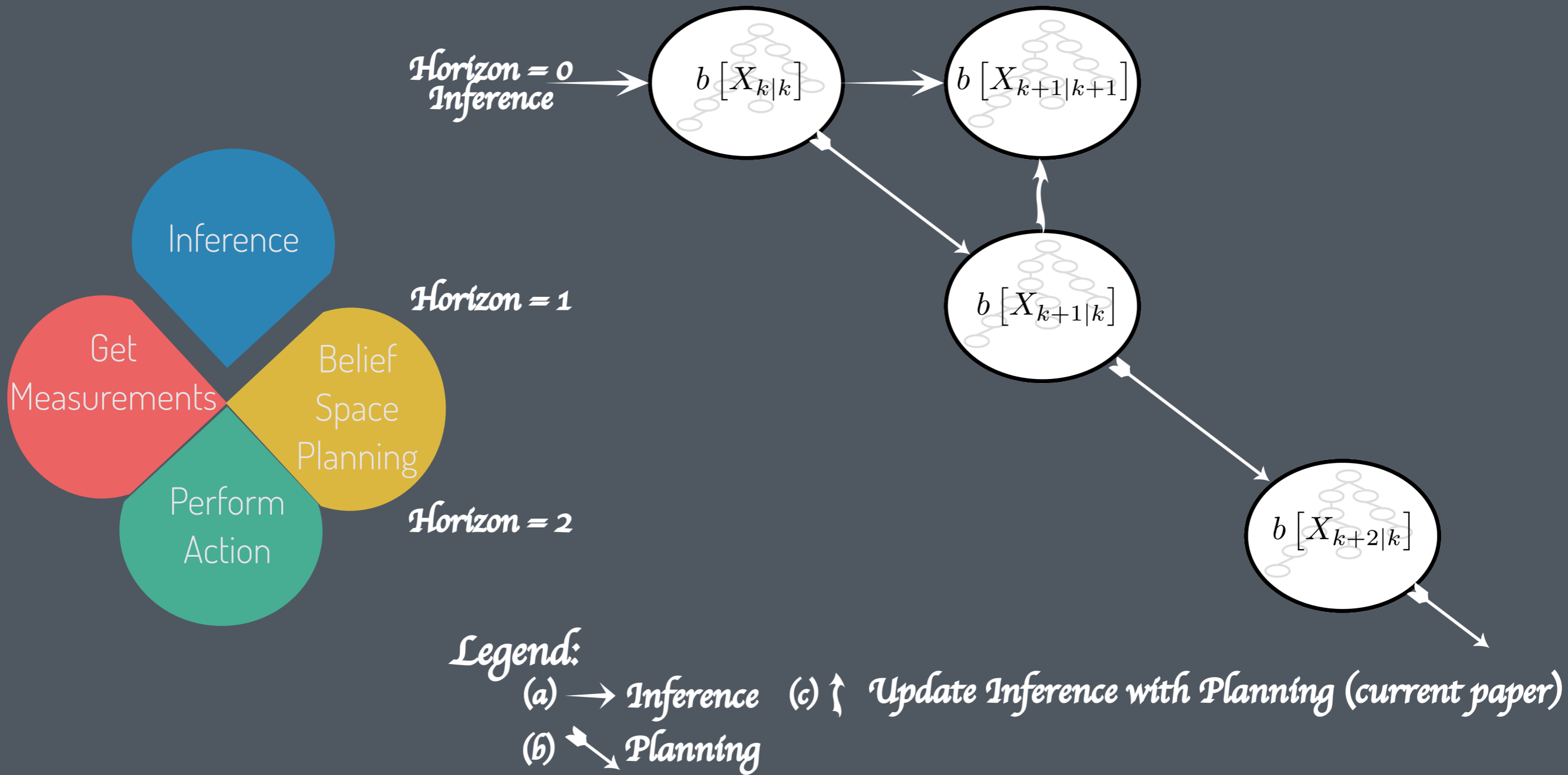
# What is Being Done Today



# Inference Update Today



# Inference Update via Precursory BSP



# Our proposed methods



Orthogonal  
Transformation  
Matrix



Down-date  
Update

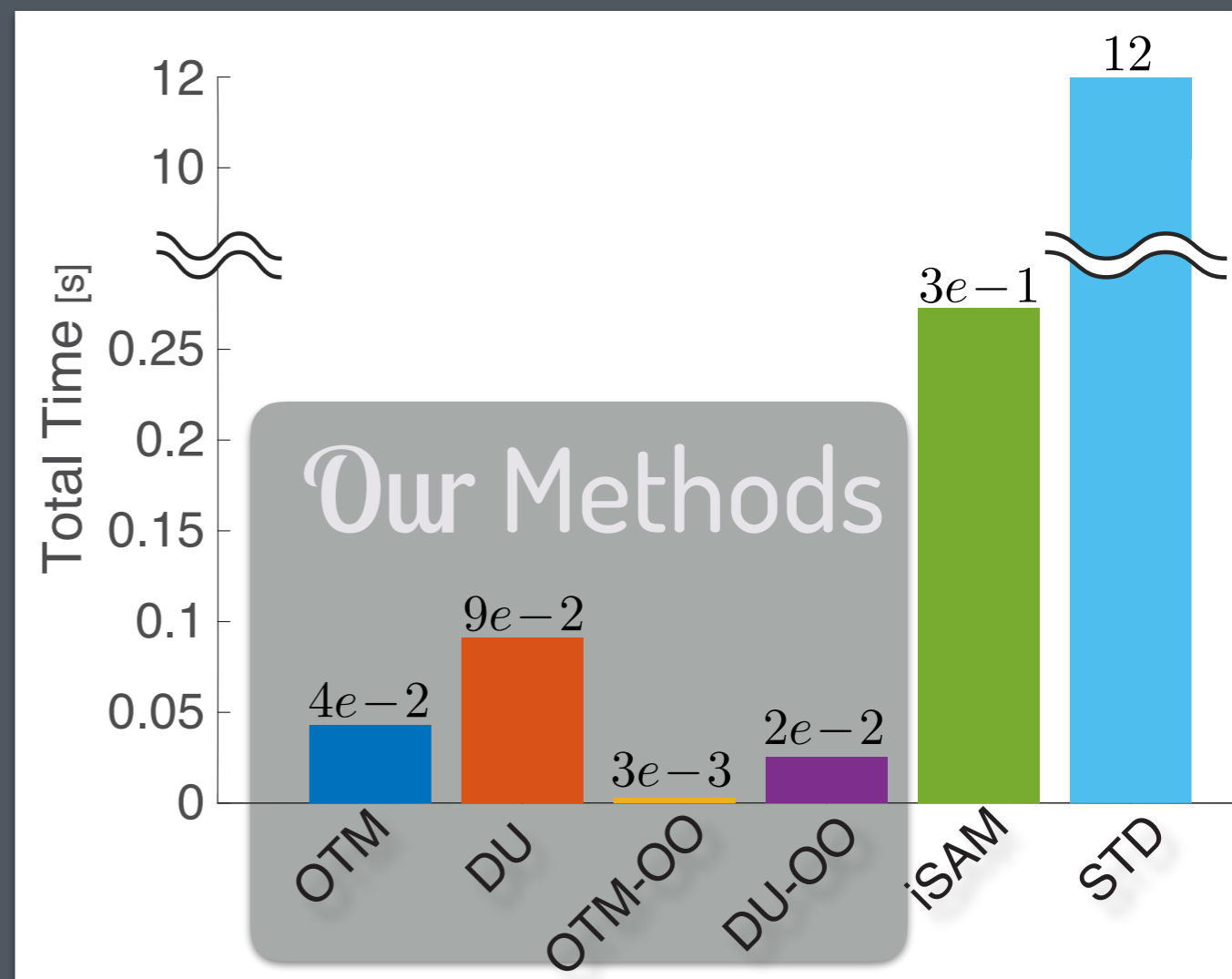
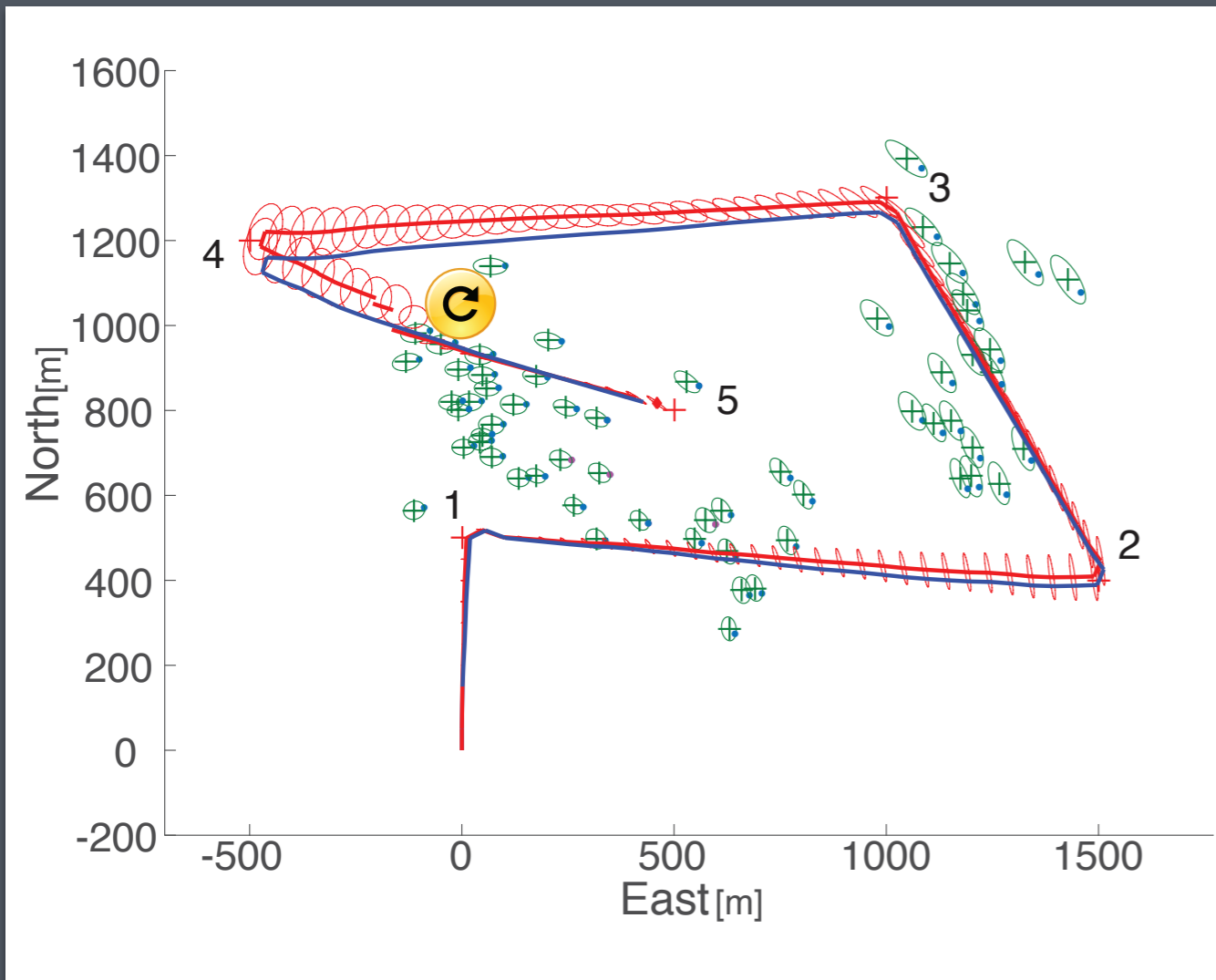


OTM - Only  
Observations

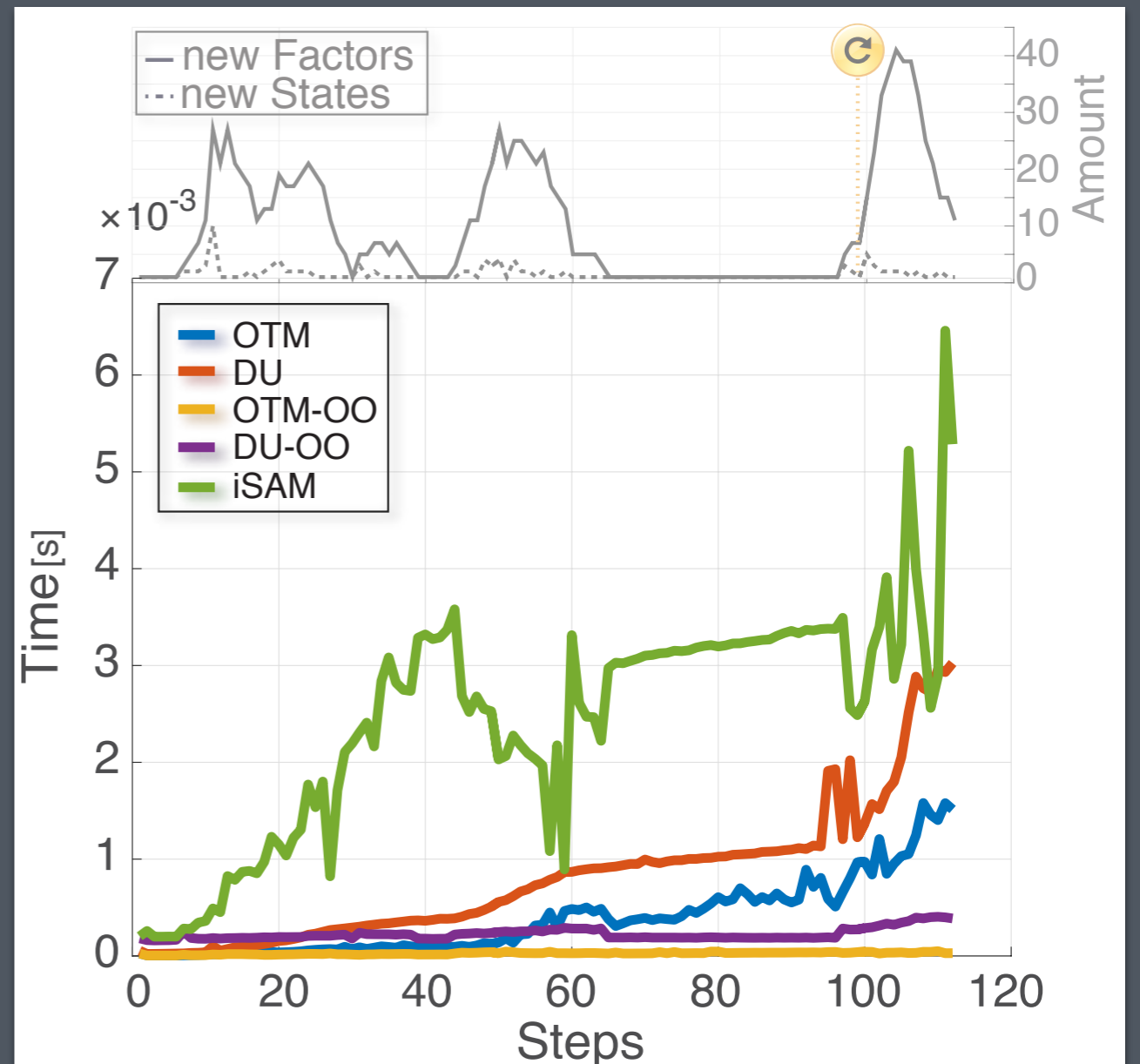
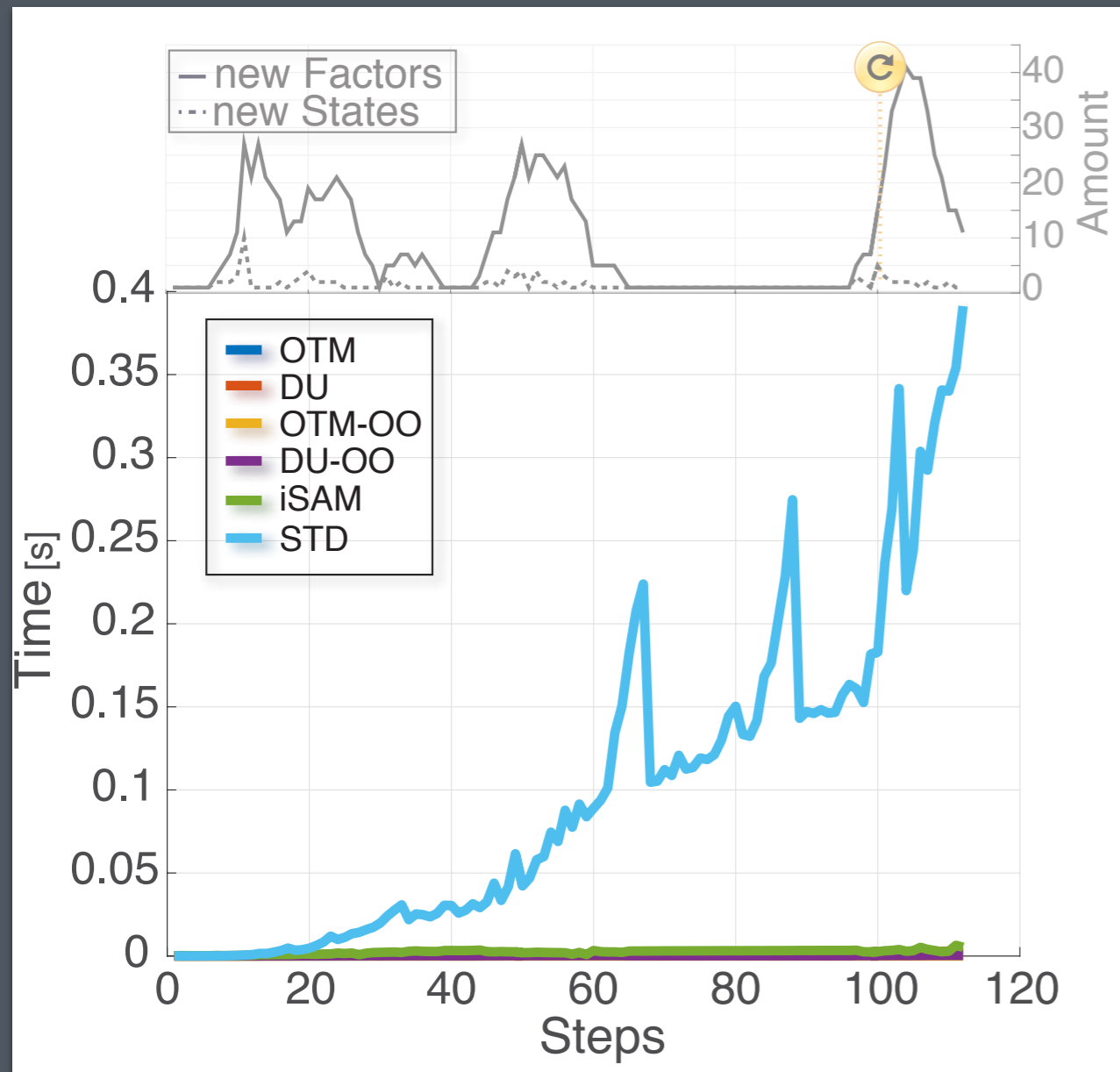


DU - Only  
Observations

# Inference Update - Total Time Comparison



# Performance Per-step





## Summing Up

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- 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  $\mathcal{OTM}\text{-}\mathcal{OO}$ , are faster by orders of magnitude and more robust to state dimensionality and loop closures
- We presented  $\mathcal{JIP}$  novel approach for joint inference and belief space planning paradigm

# Q & A Session



*Thanks for Listening  
Looking forward to answer your questions*

*@ Station #1*