school of ai

SLAM

AI FOR ROBOTICS

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SLAM

Simultaneous Localization And Mapping

SLAM

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SLAM

Source: https://youtu.be/Q3EMgGI6E5s

SLAM

Take a look: https://youtu.be/tnRJaHZH9lo?t=94

SLAM

Simultaneous Localization And Mapping

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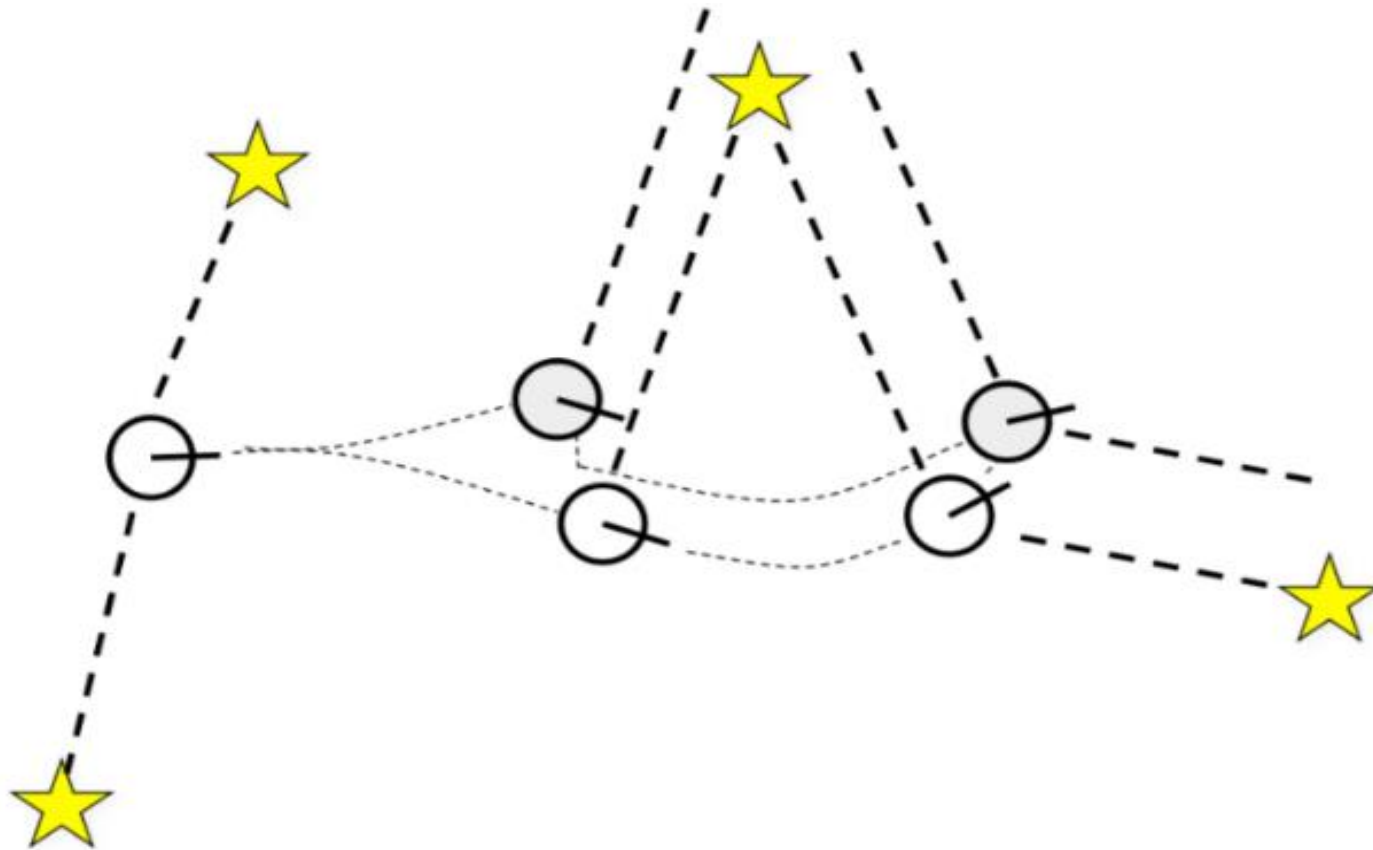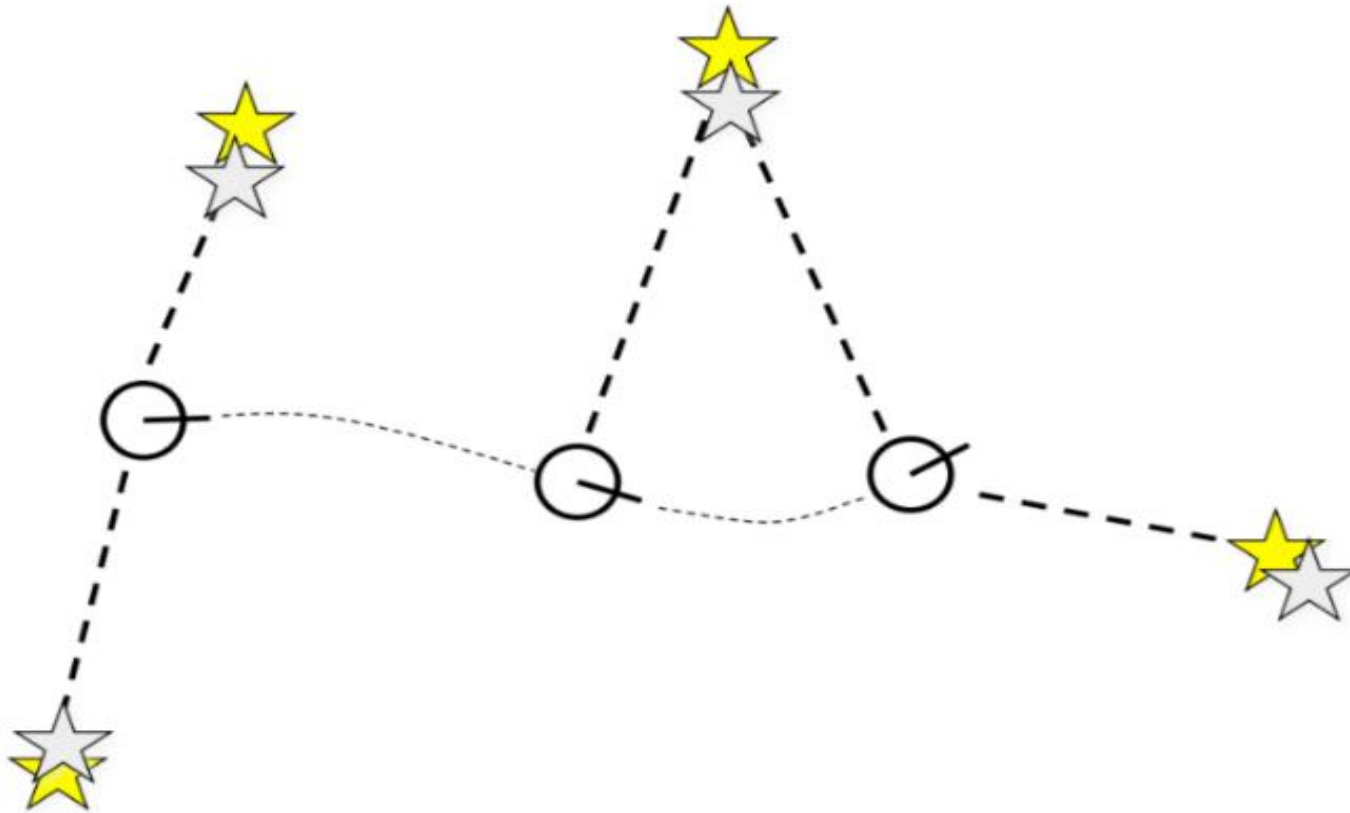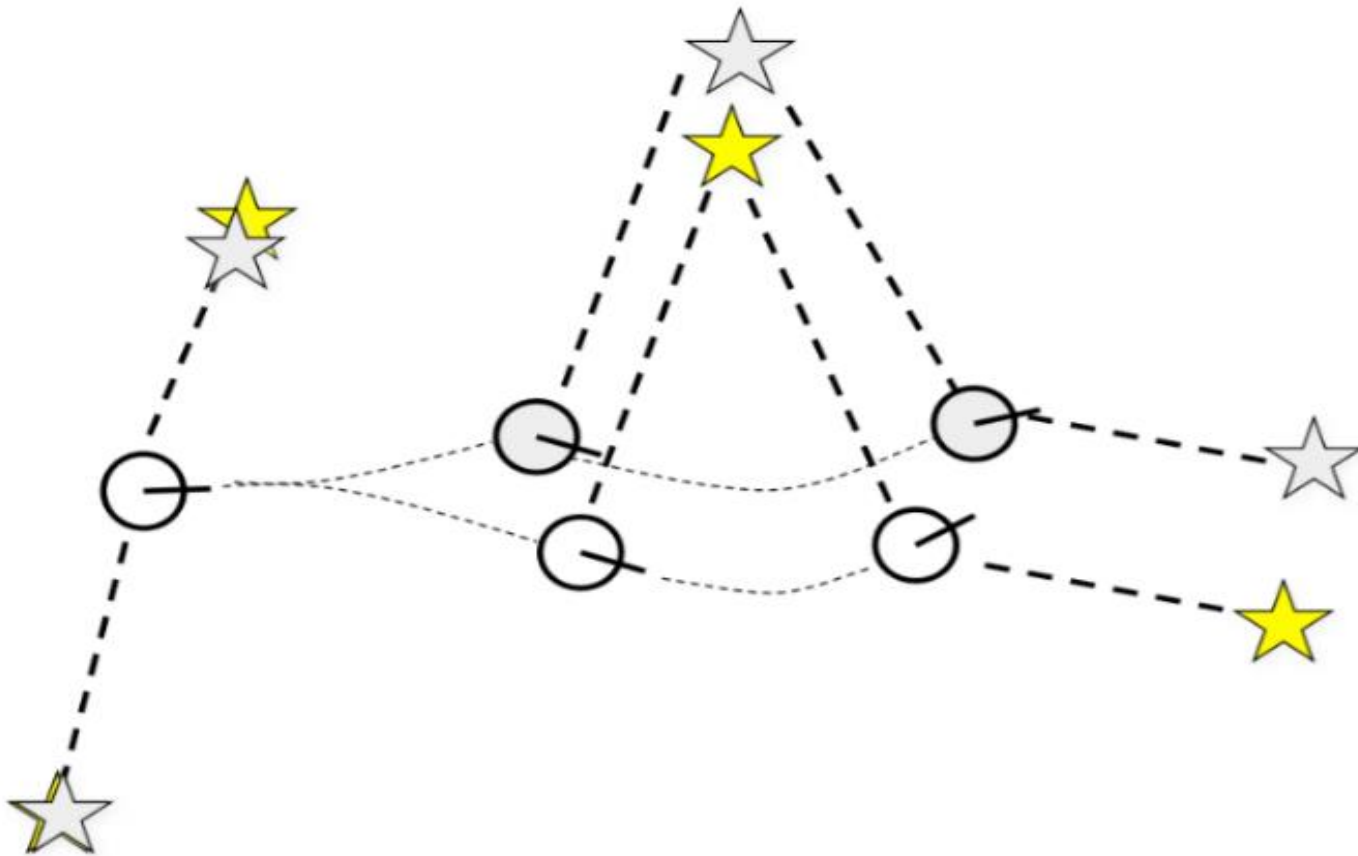
Localization example
Estimating the location of the robot by considering the known landmark positions.

Mapping example
Estimating the location of the landmarks by considering the known robot positions.

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SLAM example

Estimating the robot (camera) pose and the location of the landmarks at the same time.

- Robot

- Map

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- Robot
  - We give control signals
  - We estimate location

- Map
  - We make measurements
  - We make the map

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$$\mathbf{x}(i+1) = \begin{bmatrix} \mathbf{p}(i+1) \\ \mathbf{x}_1(i+1) \\ \vdots \\ \mathbf{x}_{M_\ell}(i+1) \end{bmatrix} = \begin{bmatrix} \mathbf{g}(\mathbf{p}(i),\mathbf{u}(i),\mathbf{w}(i)) \\ \mathbf{x}_1(i) \\ \vdots \\ \mathbf{x}_{M_\ell}(i) \end{bmatrix} \overset{def}{=} \mathbf{f}\left(\mathbf{x}(i),\mathbf{u}(i),\mathbf{w}(i)\right)$$
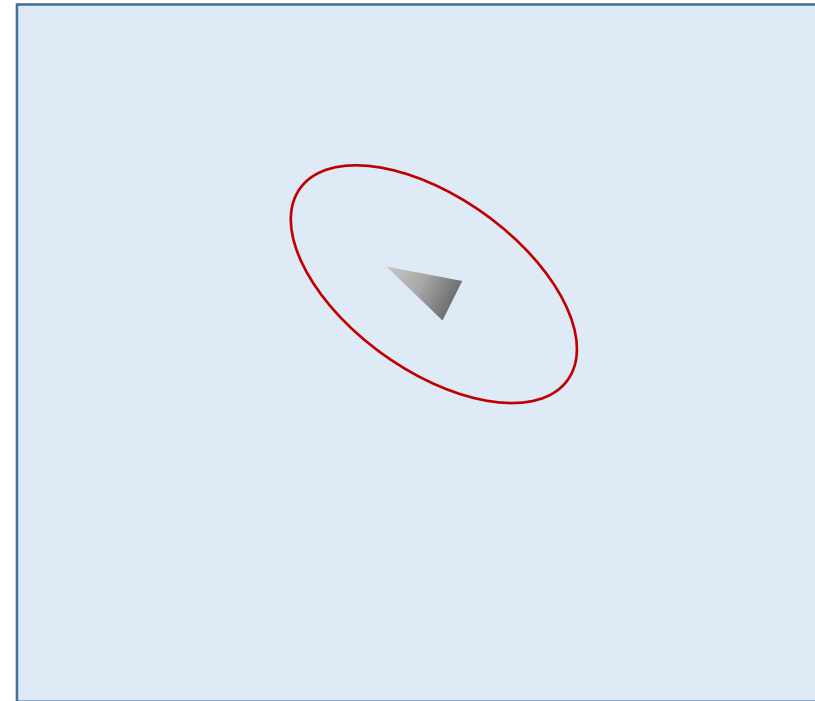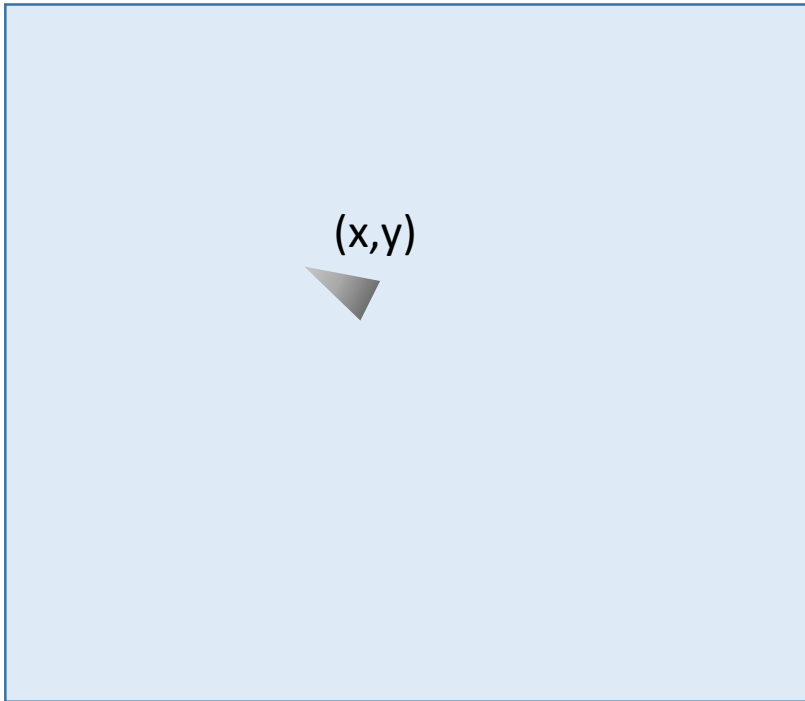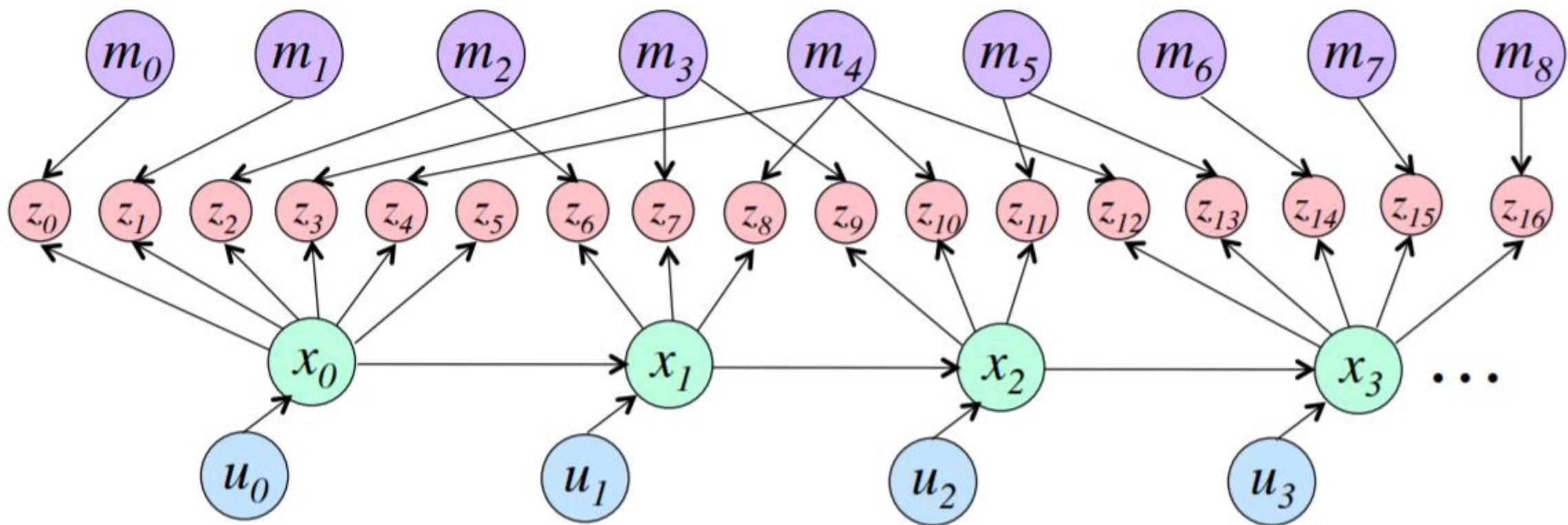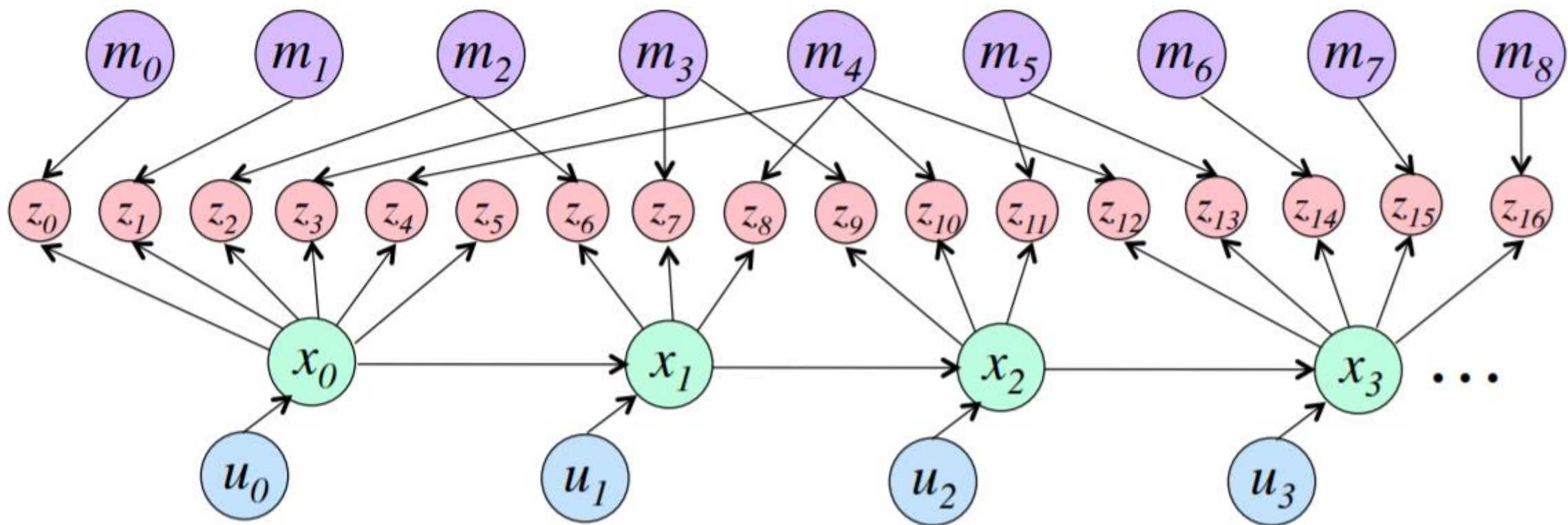
g() :   kinematic model
u() :   control signal
w(i) : progress noise
h(x) : measurement function

$$\mathbf{z}(i) = \begin{bmatrix} \mathbf{z}_1(i) \\ \vdots \\ \mathbf{z}_N(i) \end{bmatrix} = \begin{bmatrix} \mathbf{h}_1\left(\mathbf{p}(i),\mathbf{x}_{m(1)}(i)\right) \\ \vdots \\ \mathbf{h}_N\left(\mathbf{p}(i),\mathbf{x}_{m(N)}(i)\right) \end{bmatrix} + \begin{bmatrix} \mathbf{n}_1(i) \\ \vdots \\ \mathbf{n}_N(i) \end{bmatrix}$$
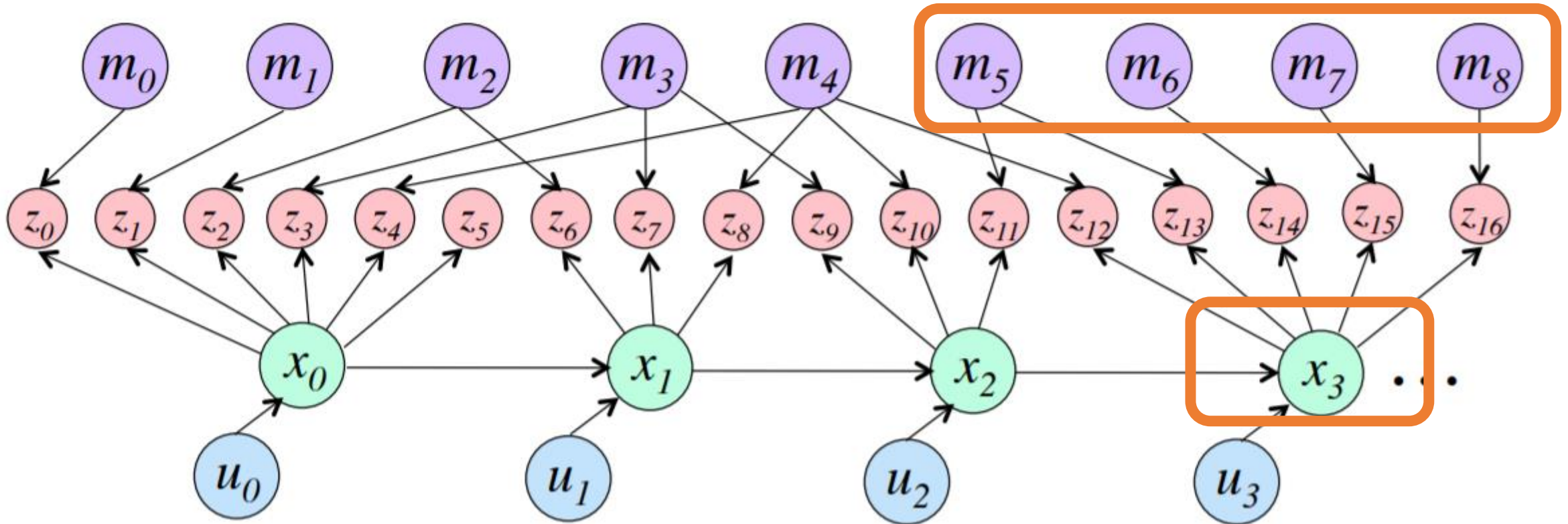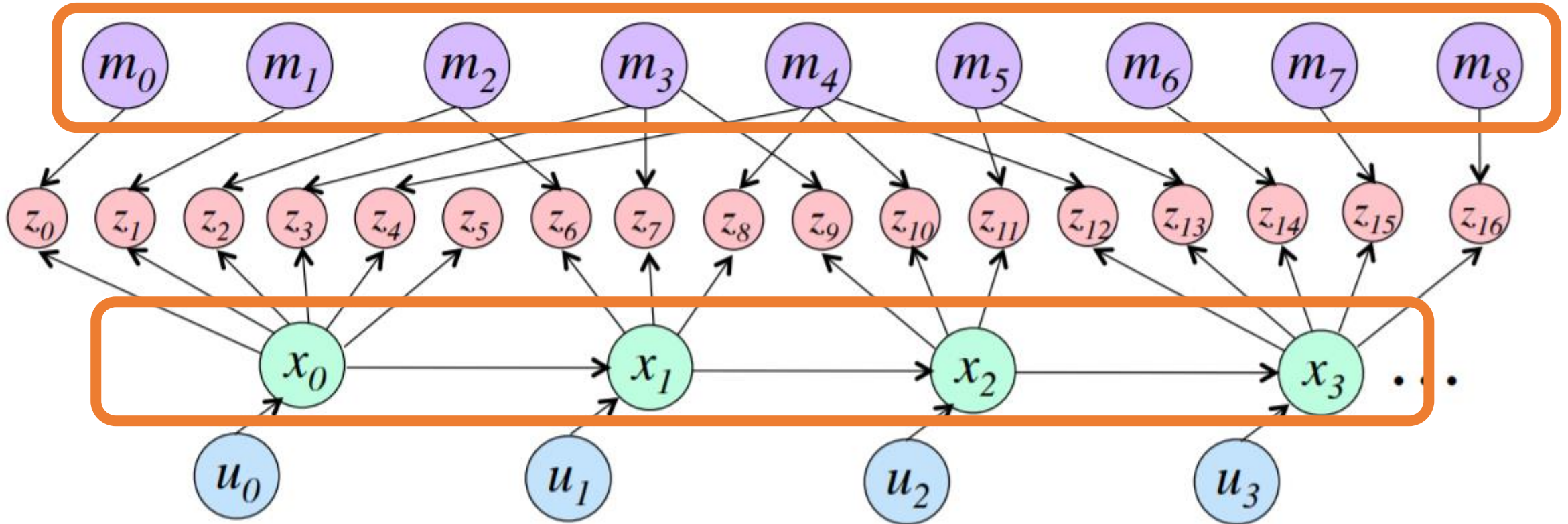
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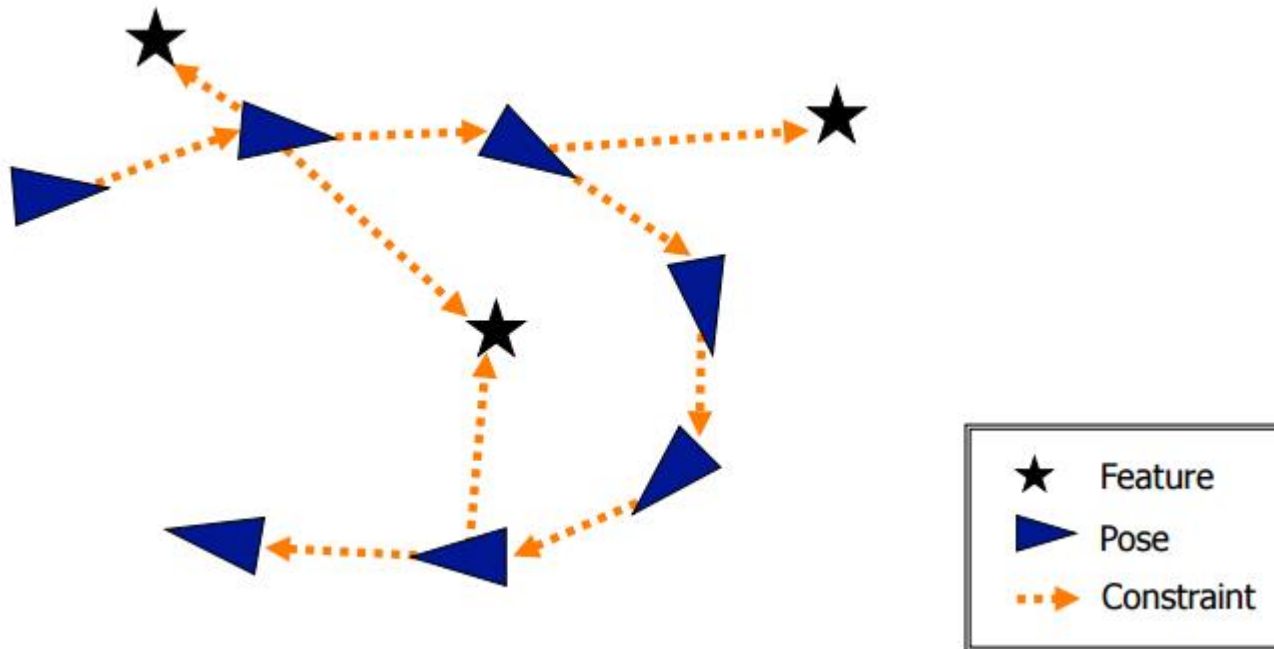
(x,y)

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ETHzurich, V4RL

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Online SLAM

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FULL SLAM

GRAPH SLAM

Smoothing

Final map.

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RTABMAP
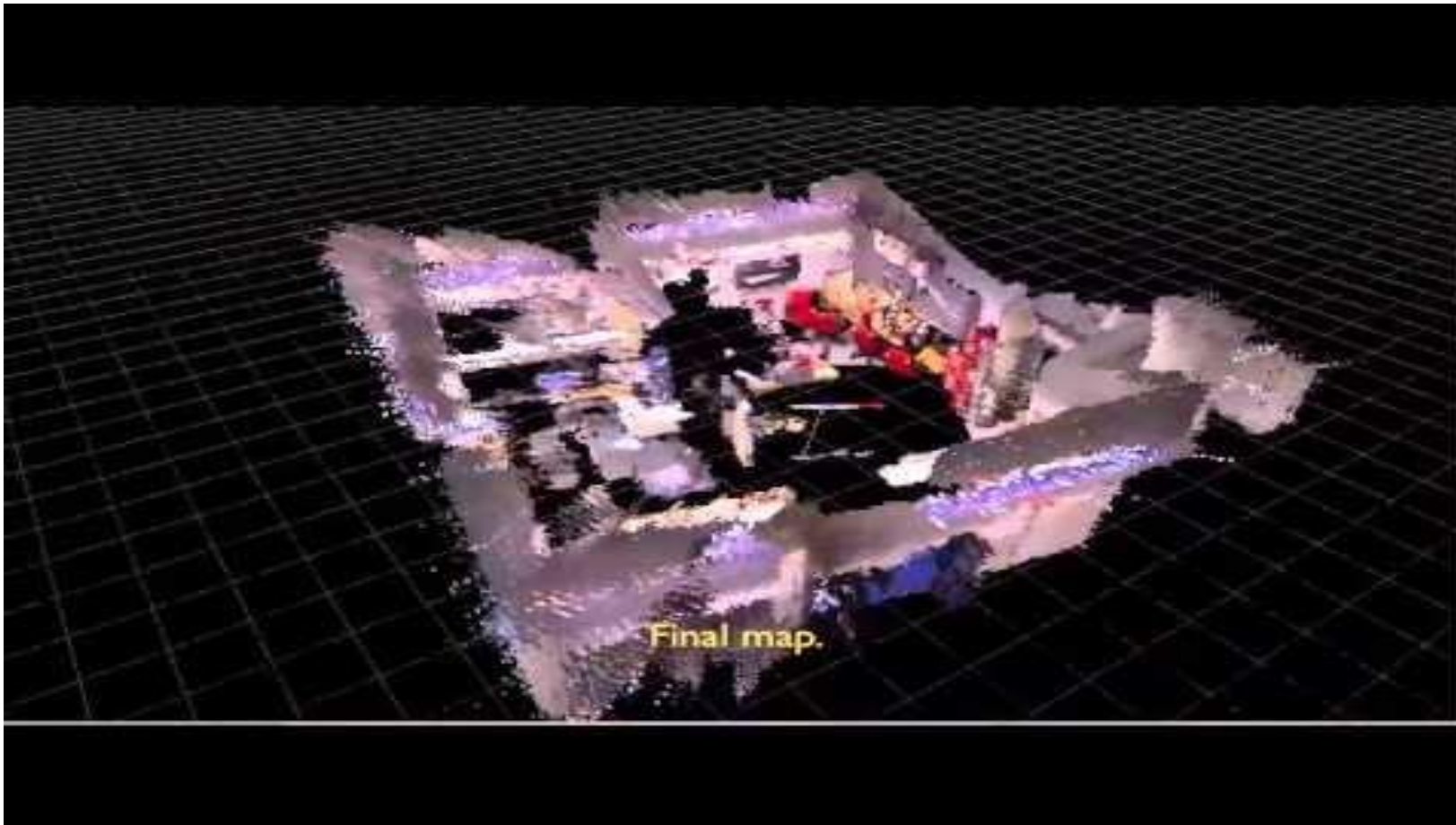
Discussion

Where is AI involved?

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Some ideas…

- Feature extraction

- Feature recognition (matching)

- Using SLAM within path planning

- Path optimization https://youtu.be/D8QoXAhFKfk

Further reading

Simultaneous Localisation and Mapping (SLAM):
Part I The Essential Algorithms

Hugh Durrant-Whyte, *Fellow, IEEE*, and Tim Bailey

Simultaneous Localisation and Mapping (SLAM):
Part II State of the Art

Tim Bailey and Hugh Durrant-Whyte