

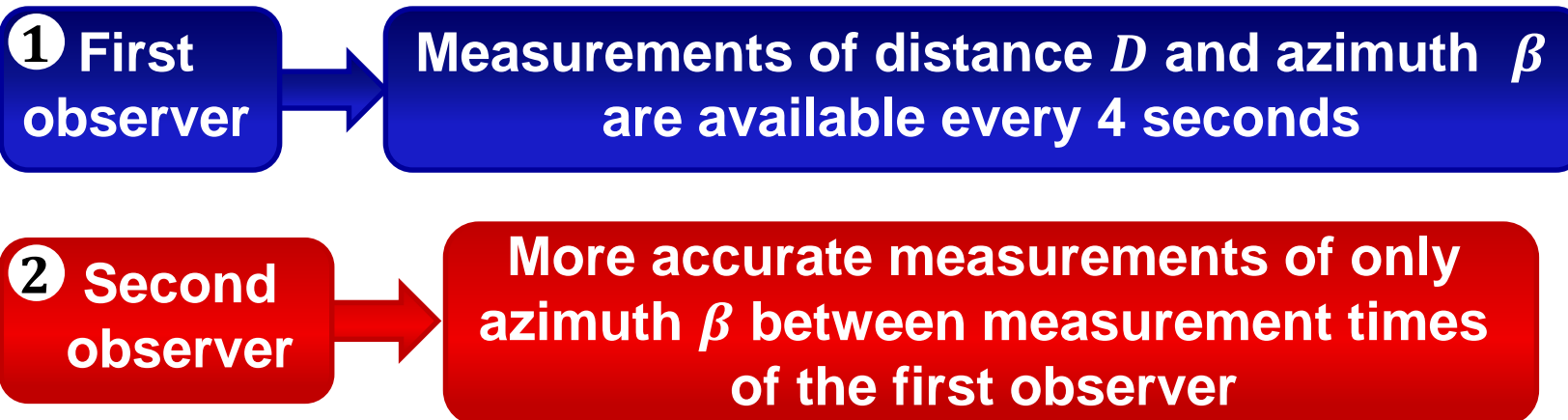
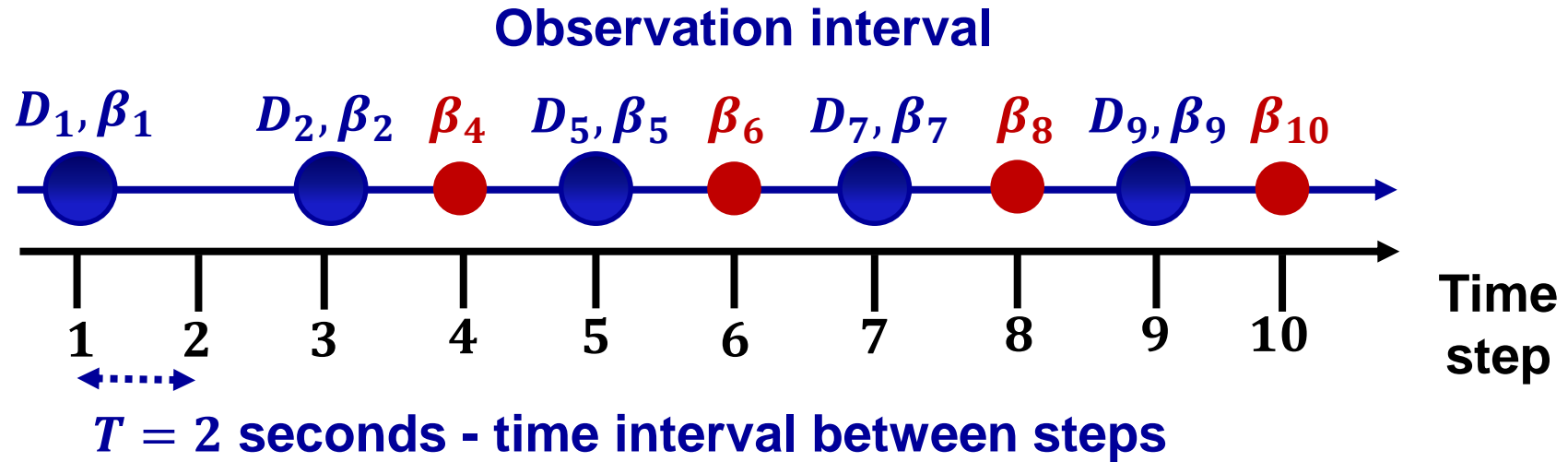
# “Experimental Data Processing”

## Assignment 12

**Joint assimilation of navigation data  
coming from different sources**

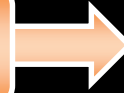
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**Term 1, September-October 2020**  
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# Navigation data coming from different sources



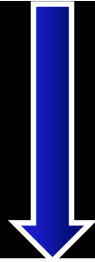
# Measurement equation for the first observer

Measurement equation



$$z_i = h(X_i) + \eta_i$$

Measurement  
vector  $z_i$



$$z_i = \begin{bmatrix} D_i^m \\ \beta_i^m \end{bmatrix}$$

Nonlinear  
function  $h(X_i)$



$$h(X_i) = \begin{bmatrix} \sqrt{x_i^2 + y_i^2} \\ \arctg\left(\frac{x_i}{y_i}\right) \end{bmatrix}$$

# Observation function for the first observer

Nonlinear  
function  $h(X_i)$

$$h(X_i) = \begin{bmatrix} \sqrt{x_i^2 + y_i^2} \\ \arctg\left(\frac{x}{y}\right) \end{bmatrix}$$

Derivative with respect  
to  $X_{i+1}$  at point  $\hat{X}_{i+1,i}$

$$\frac{dh(\hat{X}_{i+1,i})}{dX_{i+1}} = \begin{bmatrix} \frac{x_{i+1,i}}{\sqrt{x_{i+1,i}^2 + y_{i+1,i}^2}} & 0 & \frac{y_{i+1,i}}{\sqrt{x_{i+1,i}^2 + y_{i+1,i}^2}} & 0 \\ \frac{y_{i+1,i}}{x_{i+1,i}^2 + y_{i+1,i}^2} & 0 & -\frac{x_{i+1,i}}{x_{i+1,i}^2 + y_{i+1,i}^2} & 0 \end{bmatrix}$$

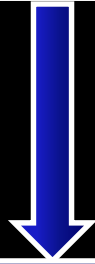
# Measurement equation for the second observer

Measurement equation



$$z_i = h(X_i) + \eta_i$$

Measurement  
vector  $z_i$



$$z_i = |\beta_i^m|$$

Nonlinear  
function  $h(X_i)$



$$h(X_i) = \left| \arctan \left( \frac{x_i}{y_i} \right) \right|$$

# Observation function for the second observer

Nonlinear  
function  $h(X_i)$



$$h(X_i) = \left| \arctg \left( \frac{x_i}{y_i} \right) \right|$$

Derivative with respect  
to  $X_{i+1}$  at point  $\hat{X}_{i+1,i}$



$$\frac{dh(\hat{X}_{i+1,i})}{dX_{i+1}} = \left| \begin{array}{cc} \frac{y_{i+1,i}}{x_{i+1,i}^2 + y_{i+1,i}^2} & 0 \\ -\frac{x_{i+1,i}}{x_{i+1,i}^2 + y_{i+1,i}^2} & 0 \end{array} \right|$$