#### **EPFL**

### Extended Kalman Filter Lab 6 – INS as model (4)

General non-linear perturbation with random noise

$$\Delta \dot{\mathbf{x}} = \underbrace{\left[\frac{\partial f()}{\partial \mathbf{x}}\right]_{\mathbf{x} = \mathbf{x}^*}^{\Delta \mathbf{x}} + \mathbf{u}(t)}_{\mathbf{F}}$$

#### 2D IMU perturbation with random noise

- **F** + **noise** together per element
- case : all errors in 'deltas' are modeled as a white noise e.g.  $\delta \dot{lpha} = \delta \omega_{mh}^b + w_g$

$$\begin{bmatrix} \delta \dot{\alpha} \\ \delta \dot{v}_{n} \\ \delta \dot{v}_{e} \\ \delta \dot{p}_{n} \\ \delta \dot{p}_{e} \end{bmatrix} = \underbrace{\begin{bmatrix} \cdot & \cdot & \cdot & \cdot & \cdot \\ -f_{2}^{m} & \cdot & \cdot & \cdot & \cdot \\ -f_{1}^{m} & \cdot & \cdot & \cdot & \cdot \\ \cdot & 1 & \cdot & \cdot & \cdot \\ \cdot & \cdot & 1 & \cdot & \cdot \end{bmatrix}}_{\mathbf{F}_{11}} \begin{bmatrix} \delta \alpha \\ \delta v_{n} \\ \delta v_{e} \\ \delta p_{n} \\ \delta p_{e} \end{bmatrix} + \underbrace{\begin{bmatrix} 1 & \cdot & \cdot & \cdot \\ \cdot & \cos \alpha & -\sin \alpha \\ \cdot & \sin \alpha & \cos \alpha \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \end{bmatrix}}_{\mathbf{G}_{11}} \begin{bmatrix} w_{g} \\ w_{a_{1}} \\ w_{a_{2}} \end{bmatrix}$$

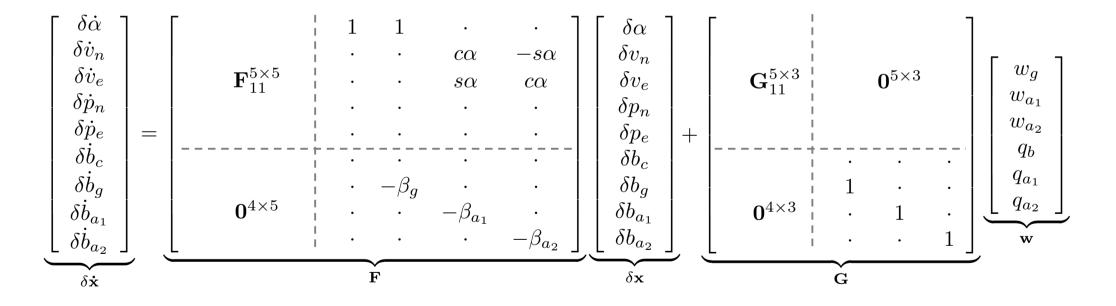
(2) perturbation of 2D INS  $\rightarrow$  **F**:

$$\delta \dot{f \alpha} = \delta \omega_{mb}^b \ \delta \dot{f v}^m = {f R}_b^m {f \Omega}_{mb}^b {f f}^b + {f R}_b^m \delta {f f}^b \ \delta \dot{f p}^m = \delta {f v}^m$$

#### **EPFL**

## Extended Kalman Filter Lab 6 – INS as model (7) details

Refer to Lab 6 help and/or black-board  $c\alpha \to \cos \alpha \atop s\alpha \to \sin \alpha$ 



# Extended Kalman Filter Lab 6 – INS as model (9) - flowchart

