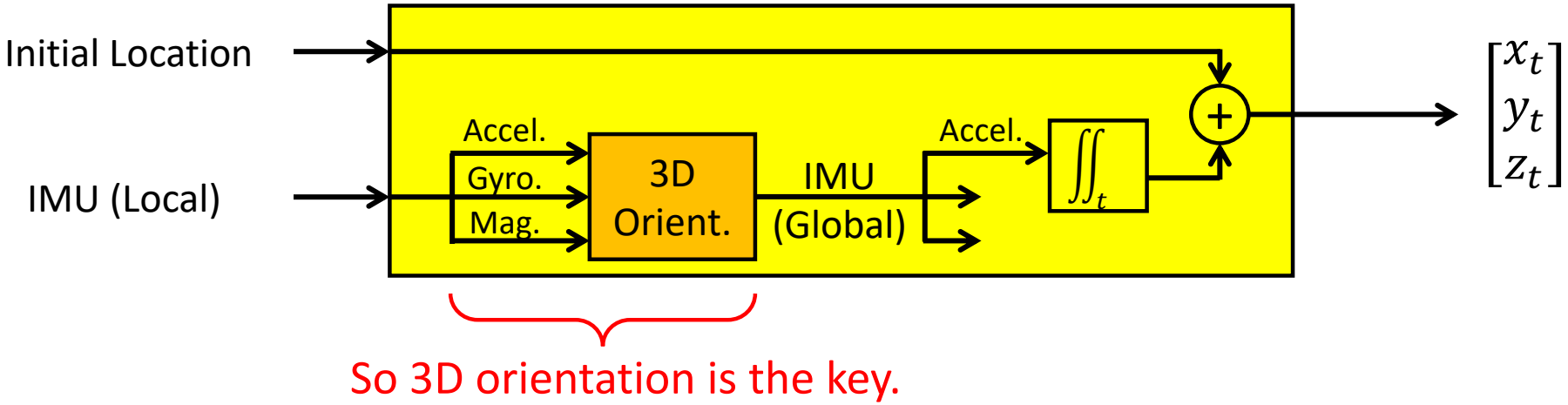
So, how will orientation solve the problem?

What we need to do is:



So 3D orientation is the key.

So how to get 3D orientation?

2 Main Opportunities: 1. Gravity 2. Magnetic North

Both measurable by IMU

Key idea: What rotation is needed such that

1) **Gravity** is exactly in my **downward** direction
2) **North** is exactly in my **frontward** direction

So how to get 3D orientation?

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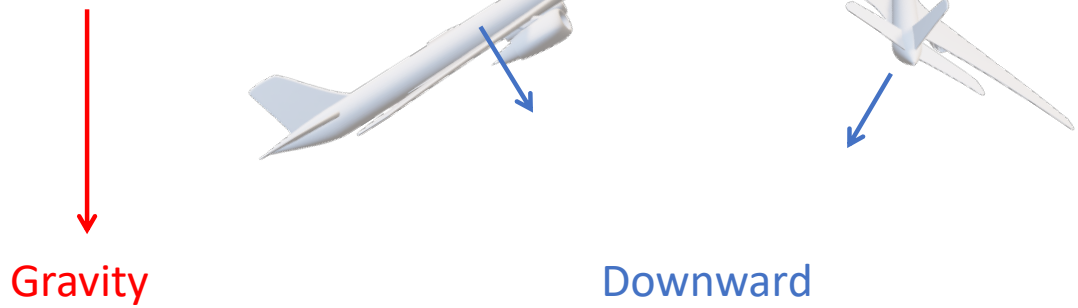
$$\begin{bmatrix} 3\times3 \\ \text{Rotation} \\ \text{Matrix} \end{bmatrix} \begin{bmatrix} a_x \\ a_y \\ a_z \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ -9.8 \end{bmatrix}$$

Tilt is determined (2 out of 3 DoFs)

Gravity says a lot about orientation, but not sufficient



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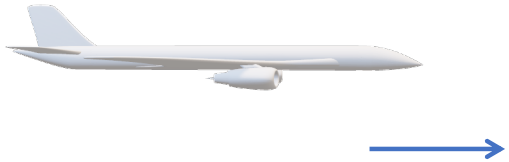
Tilt + Heading is determined (all 3 DoFs)

$$\begin{bmatrix} 3\times3 \\ \text{Rotation} \\ \text{Matrix} \end{bmatrix} \begin{bmatrix} a_x & m_x \\ a_y & m_y \\ a_z & m_z \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 100 \\ -9.8 & 0 \end{bmatrix}$$



My orientation

North

Frontward

So is Gravity + North enough to get 3D Orientation?

Only when object is **static** … but not otherwise. **Why?**

So is Gravity + North enough to get 3D Orientation?

Only when object is **static** … but not otherwise. **Why?**

Because any motion of the object will reflect in the accelerometer … thereby

polluting the gravity estimate

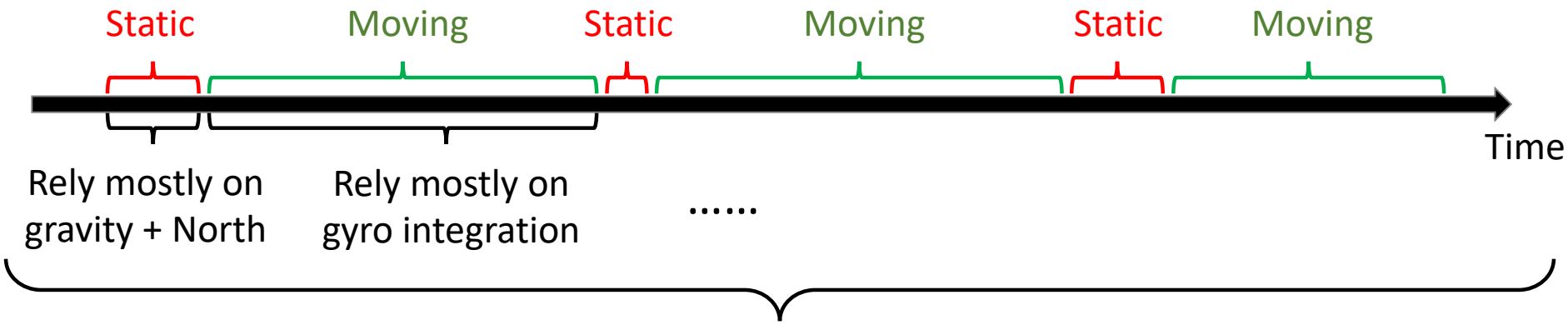
So how to get 3D orientation? (Another idea)

Another Idea for Orientation: Integrate angular velocity from gyro

$$\text{Initial Orientation} + \int_0^t (Gyro.)\, dt = \text{New Orientation (at time } t\text{)}$$

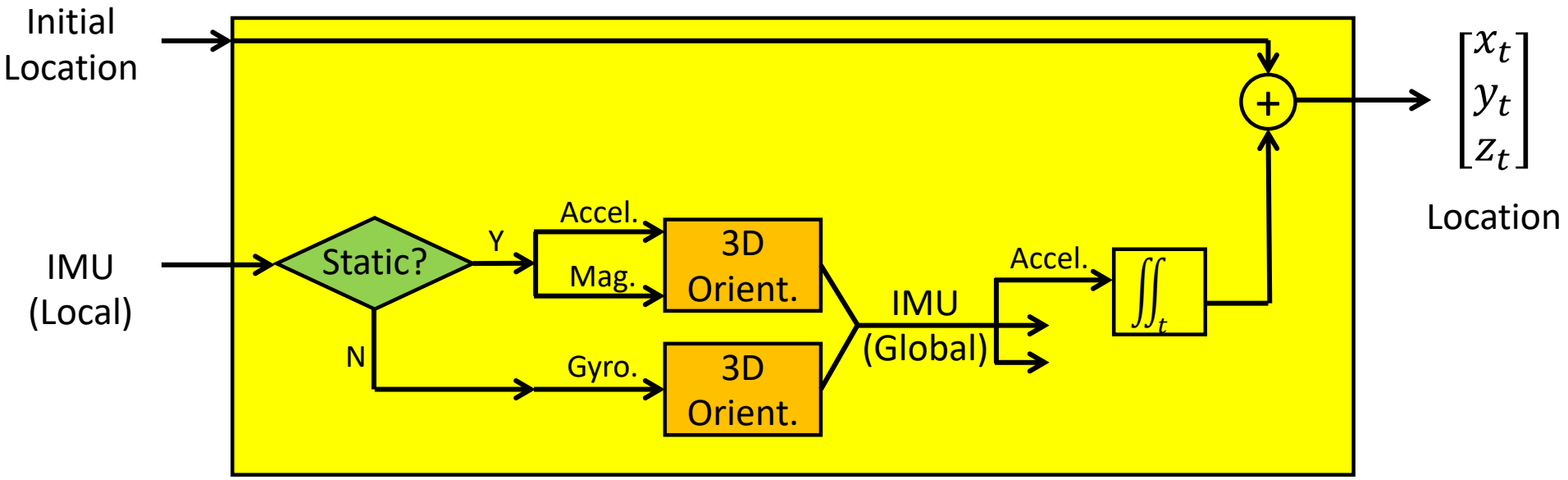
But gyro drifts, so only useful in short time scales

State of the art today: **Sensor Fusion**

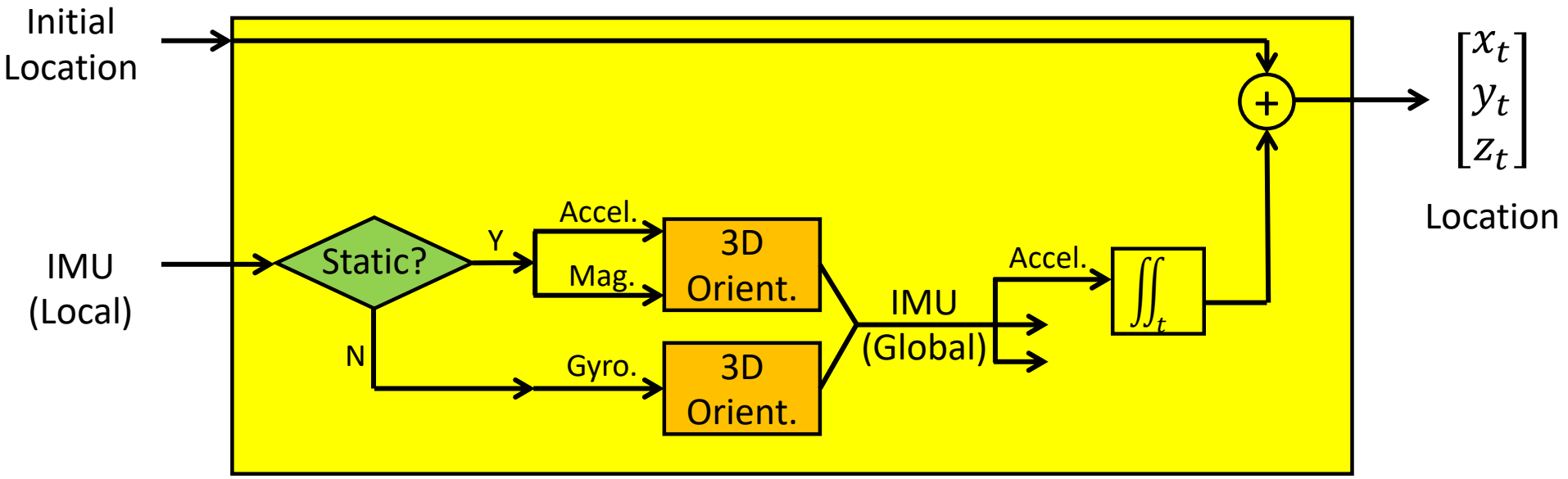


Always know 3D orientation

Getting back to our goal



Getting back to our goal



Main take away: Gravity is the main anchor for 3D orientation

But what if object is not often static

But what if object is not often static

But what if object is not often static

No good solution today …

Your job to solve the problem …

Questions ?