

RT-KalmanNet:

A Robust Tailored Neural Network Aided Kalman Filtering Approach

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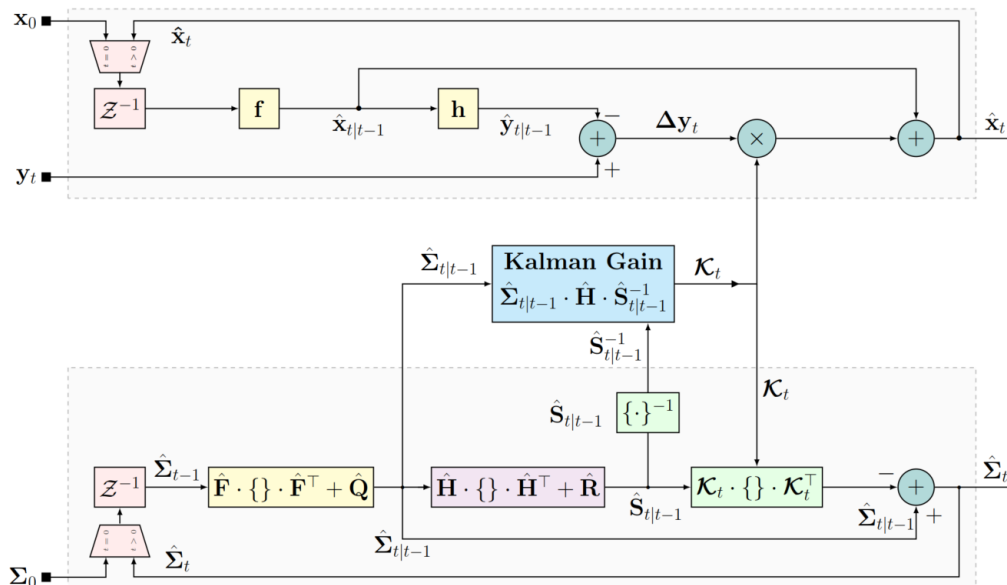
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State of Art: EKF – a model-based estimator

State space model:

$$\mathbf{x}_t = \mathbf{f}(\mathbf{x}_{t-1}) + \mathbf{w}_t, \quad \mathbf{w}_t \sim \mathcal{N}(\mathbf{0}, \mathbf{Q}), \quad \mathbf{x}_t \in \mathbb{R}^m, \quad (1a)$$

$$\mathbf{y}_t = \mathbf{h}(\mathbf{x}_t) + \mathbf{v}_t, \quad \mathbf{v}_t \sim \mathcal{N}(\mathbf{0}, \mathbf{R}), \quad \mathbf{y}_t \in \mathbb{R}^n. \quad (1b)$$



EKF block diagram.

1. Knowledge of the noise is not available.

2. The functions \mathbf{f} and \mathbf{h} does not match the true one:

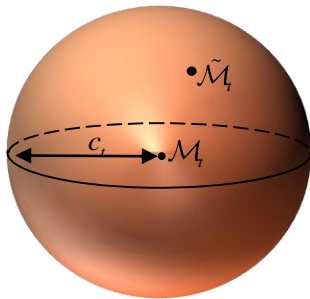
- the representation of continuous time dynamics in discrete time;
- Acquisition using misaligned sensors;
- other forms of mismatches...

Uncertainty!!!

Perform poorly!!!

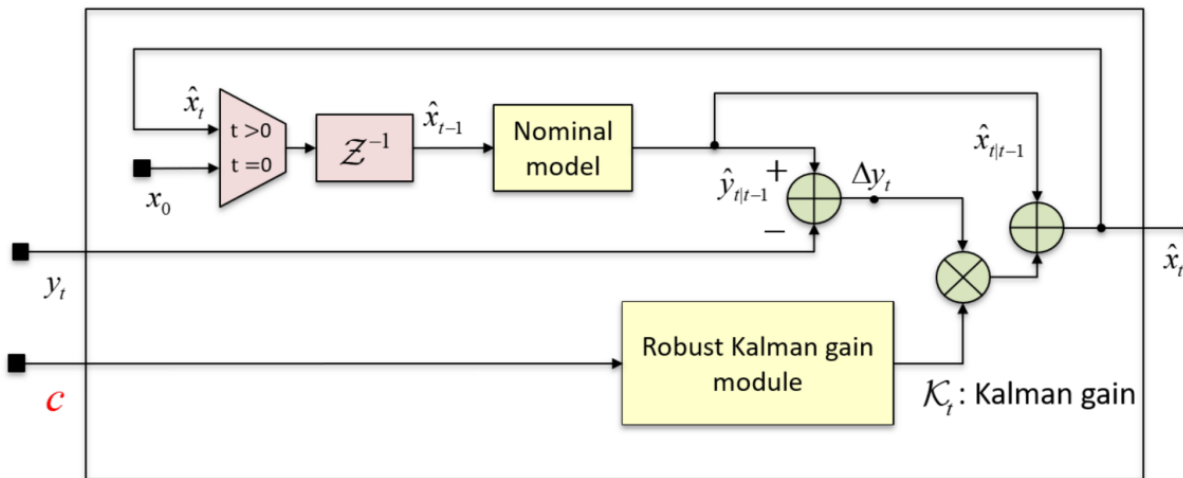
State of Art: Robust EKF

Ambiguity set



- \mathcal{M}_t : Nominal model;
- $\tilde{\mathcal{M}}_t$: Actual model;
- c_t : Tolerance.

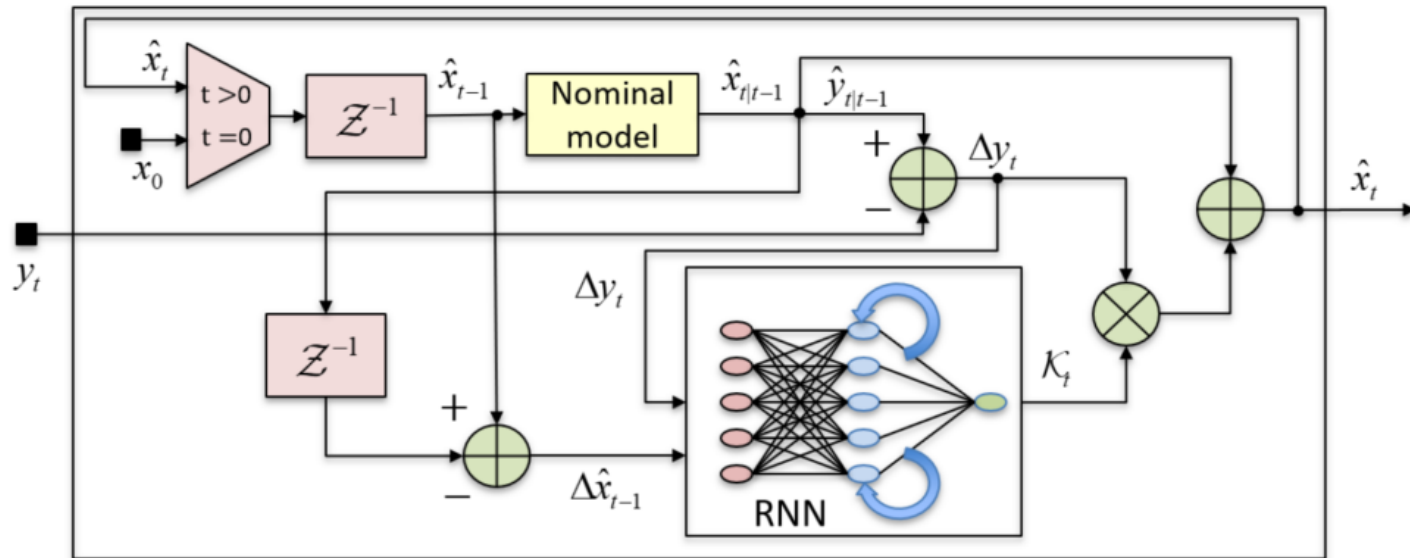
Time-varying!!!



Robust EKF block diagram.

Knowledge of the
tolerance is not available.

State of Art: KalmanNet

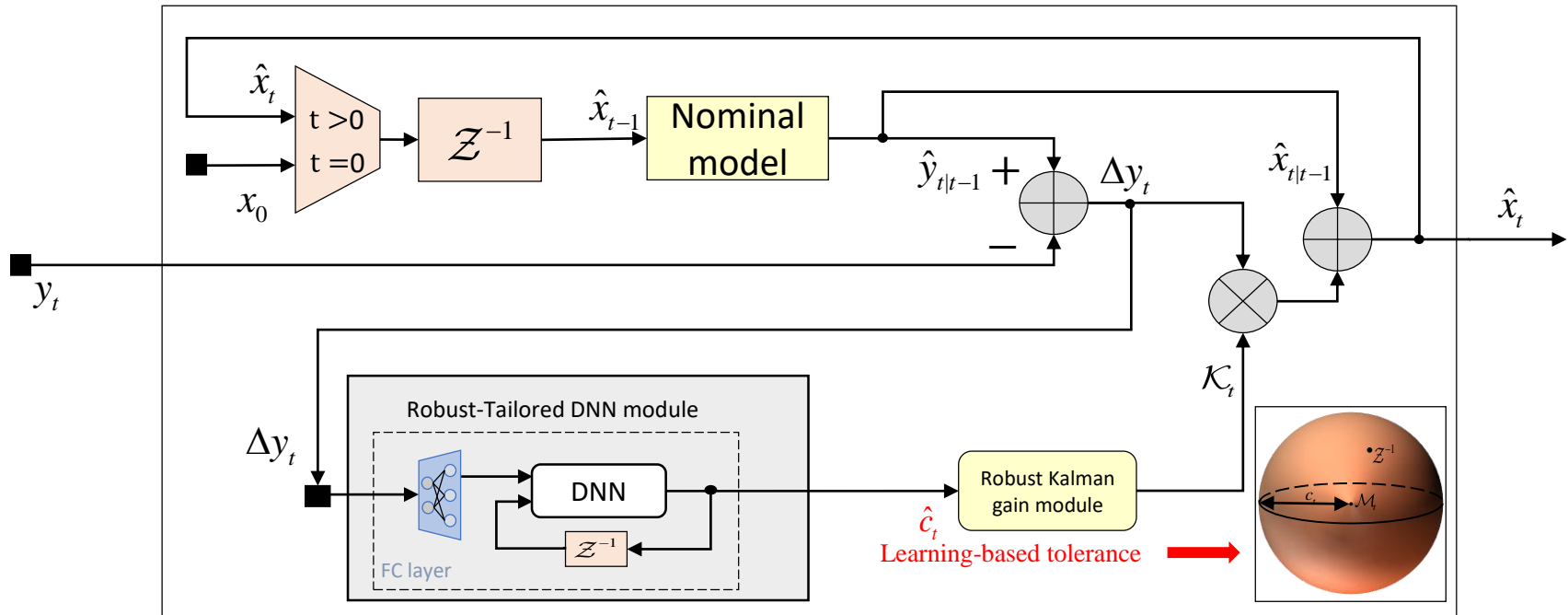


KalmanNet block diagram

Disadvantages

- Vulnerable to model uncertainty
- Substantial over-parameterization
- High complexity
- State label measurable

RT-KalmanNet



RT-KalmanNet diagram.

Implement the RT-KalmanNet and test it using the Synthetic Non-Linear Model:

- Compare the running time between REKF, KalmanNet and RT-KalmanNet;
- Compare the performance between REKF, KalmanNet and RT-KalmanNet.



Thank you for your attention!

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