Visit to Penn State

Dec. 16-19 2015

IMM history

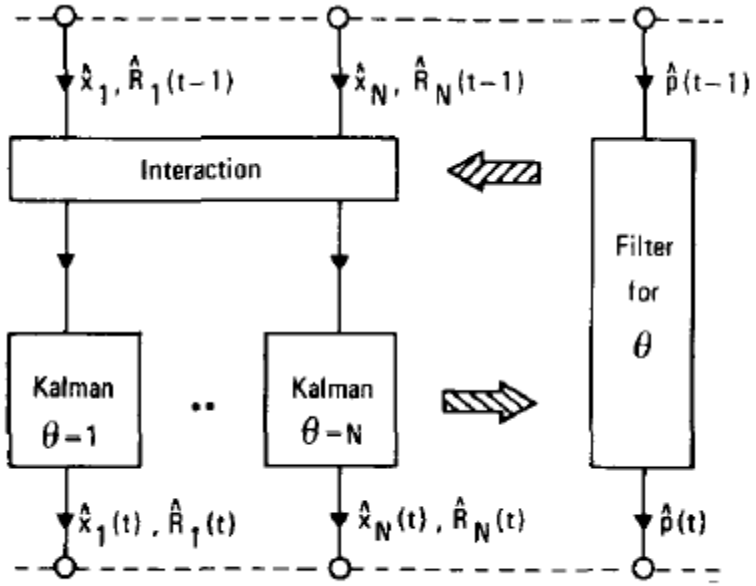


Fig. 1. The IMM algorithm.

Henk A. P. Blom And Yaakov Bar-shalom. "**The Interacting Multiple Model Algorithm for Systems with Markovian Switching Coefficients.**" IEEE Transaction on Automatic Control, 1988.

IMM history

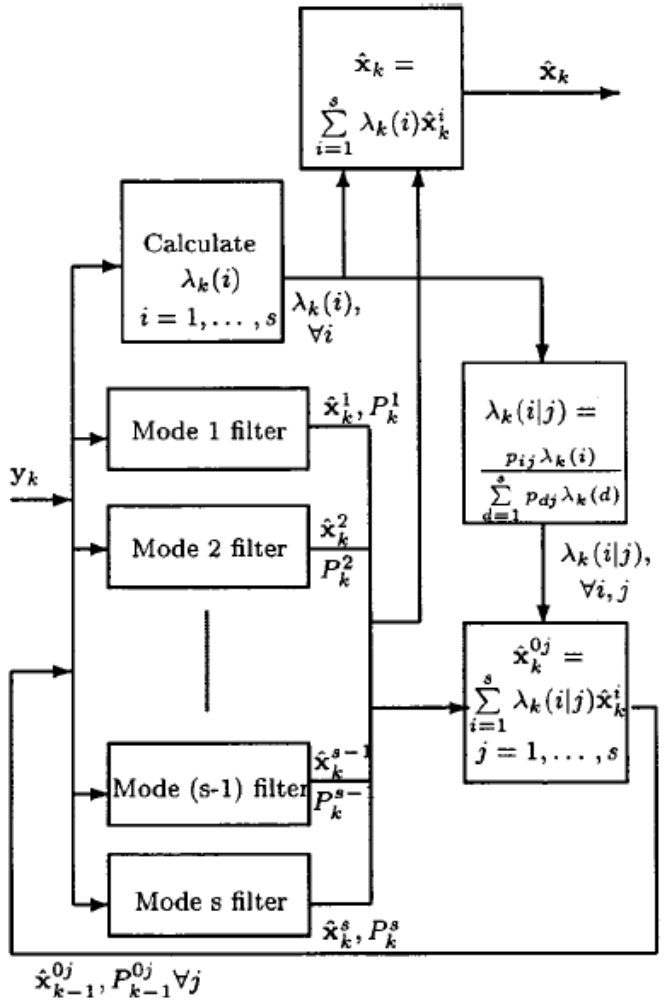
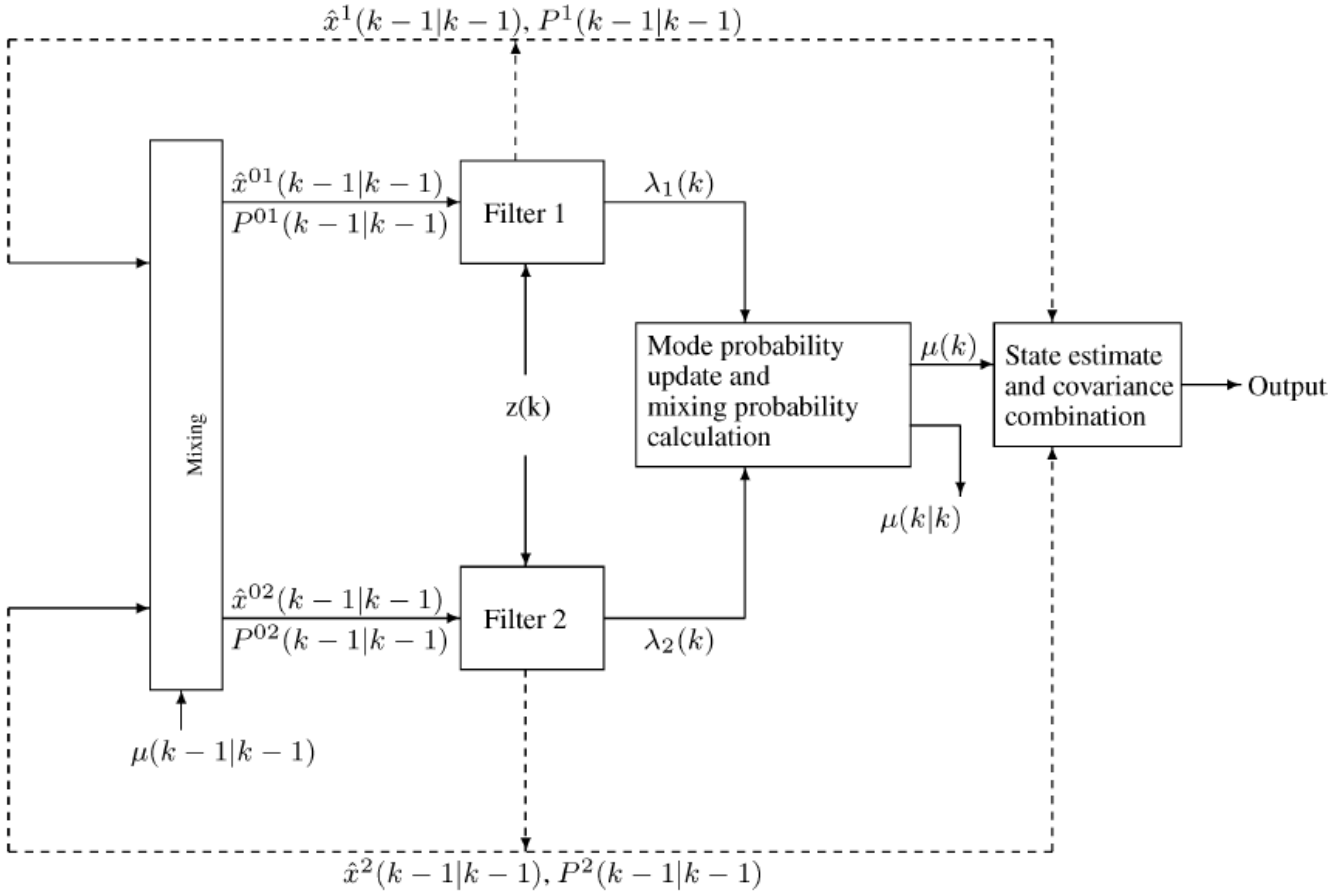


Fig. 1. Structure of the IMM algorithm.

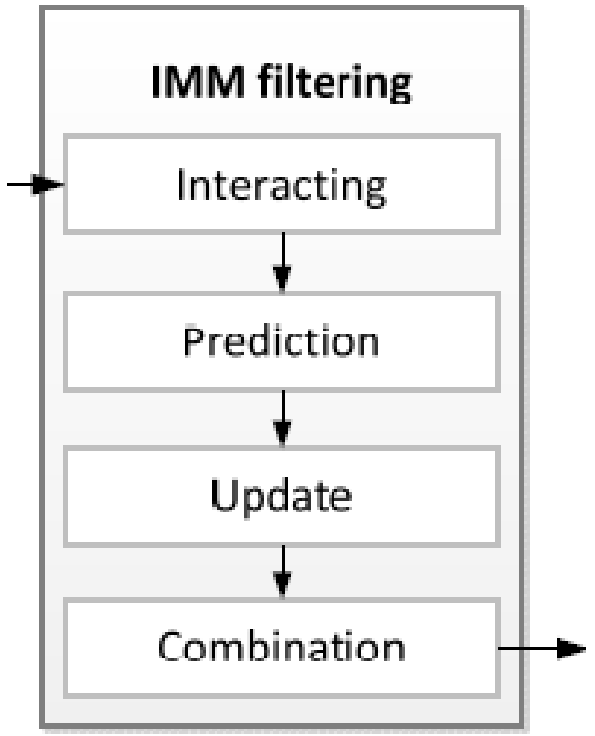
Leigh A. Johnston and Vikram Krishnamurthy. **"An Improvement to the Interacting Multiple Model (IMM) Algorithm."** IEEE Transactions on Signal Processing, 2001.

IMM history



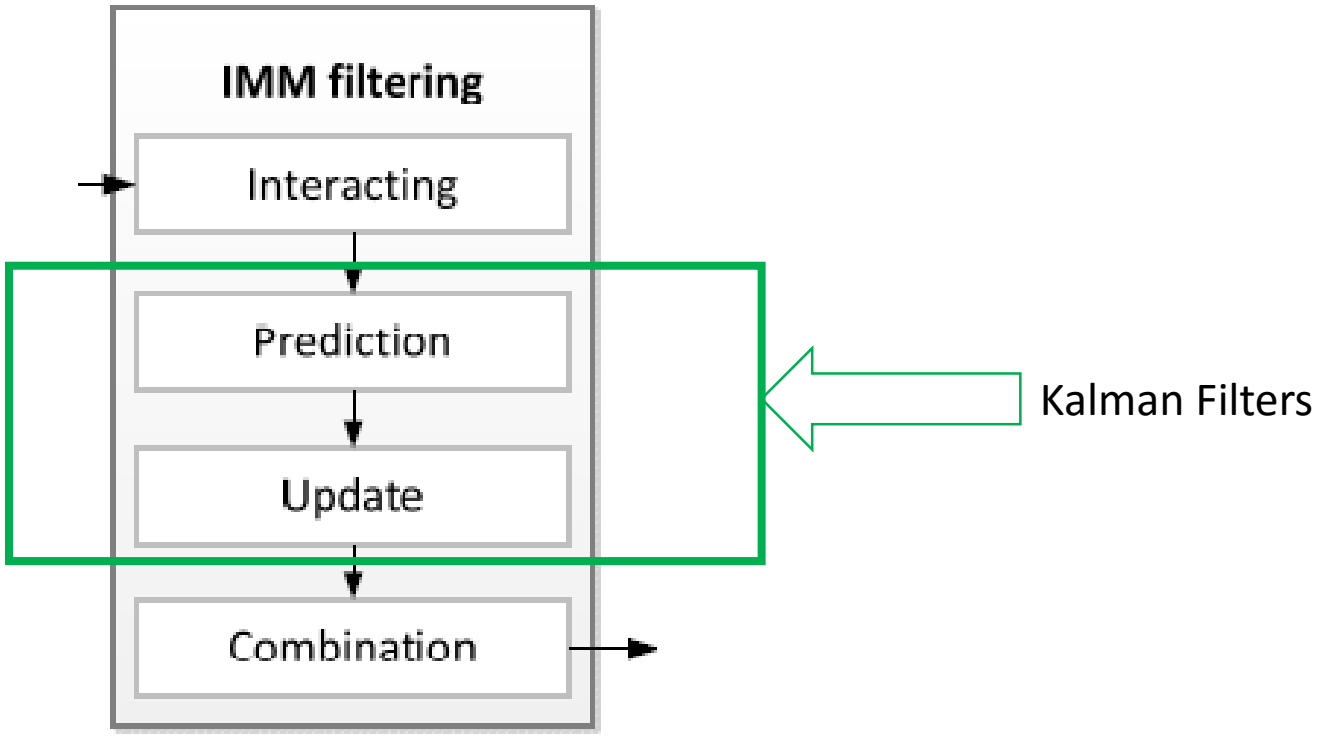
Thuraiappah Sathyan and Thiagaligam Kirubarajan. **"Markov-Jump-System-Based Secure Chaotic Communication".** IEEE Transactions on Circuits and Systems, 2006.

IMM structure



Taehwan Cho, Changho Lee and Sangbang Choi. **"Multi-Sensor Fusion with Interacting Multiple Model Filter for Improved Aircraft Position Accuracy."** Sensors, 2013.

IMM structure



Taehwan Cho, Changho Lee and Sangbang Choi. **"Multi-Sensor Fusion with Interacting Multiple Model Filter for Improved Aircraft Position Accuracy."** Sensors, 2013.

IMM equations

$$\hat{X}_{j0}(k \mid k) = \sum_{i=1}^{N} \hat{X}_i(k \mid k) \times \mu_{i,j}(k) \qquad (10)$$

$$P_{j0}(k \mid k) = \sum_{i=1}^{N} [P_i(k \mid k) + (\hat{x}_{j0}(k \mid k) - \hat{x}_i(k \mid k)) \times (\hat{x}_{j0}(k \mid k) - \hat{x}_i(k \mid k))^T] \times \mu_{ij}(k). \qquad (13)$$

Mixing/Interaction

$$\hat{\mu}_j(k+1 \mid k) = \sum_{i=1}^{N} \pi(i,j)\mu_i(k). \qquad (12)$$

$$\mu_{i,j}(k) = \frac{\pi(i,j) \times \mu_i(k)}{\hat{\mu}_j(k+1 \mid k)} \qquad (11)$$

IMM equations

$$\hat{X}_j(k+1 \mid k) = F \times \hat{X}_{j0}(k \mid k) \qquad (14)$$

$$P_j(k+1 \mid k) = F \times P_{j0}(k \mid k) \times F^T + Q \qquad (15)$$

Prediction

IMM equations

$$e_j(k+1) = z(k+1) - H \times \hat{X}_j(k+1 \mid k), \qquad (16)$$

$$S_j(k+1) = H \times P_j(k+1 \mid k) \times H_j^T + R_j, \qquad (17)$$

$$K_j(k+1) = P_j(k+1 \mid k) \times H_j^T \times (S_j(k+1))^{-1}, \qquad (18)$$

$$\hat{X}_j(k+1 \mid k+1) = \hat{X}_j(k+1 \mid k) + K_j(k+1) \times e_j(k+1), \qquad (19)$$

$$P_j(k+1 \mid k+1) = P_j(k+1 \mid k) - K_j(k+1) \times S_j(k+1) \times K_j^T(k+1). \qquad (20)$$

Update

IMM equations

$$L_j(k+1) = \left(\left|2\pi S_j(k+1)\right|\right)^{-1} \exp\left(-\frac{1}{2} e_j^T(k+1) S_j^{-1} e_j(k+1)\right). \tag{21}$$

$$\mu_j(k+1) = \frac{\hat{\mu}_j(k+1 \mid k) L_j(k+1)}{\sum_{j=1}^{N} \hat{\mu}_j(k+1 \mid k) L_j(k+1)}, \tag{22}$$

Likelihood/ mode probabilities update

IMM equations

$$\hat{X}(k+1 \mid k+1) = \sum_{j=1}^{N} \hat{X}_j(k+1 \mid k+1)\mu_j(k+1) \quad (23)$$

$$\begin{aligned} P(k+1 \mid k+1) = \sum_{j=1}^{N} \Big[& P_j(k+1 \mid k+1) \\ & + \Big(\hat{X}(k+1 \mid k+1) \\ & - \hat{X}_j(k+1 \mid k+1)\Big) \\ & \times \Big(\hat{X}(k+1 \mid k+1) \\ & - \hat{X}_j(k+1 \mid k+1)\Big)^T \Big] \times \mu_j(k+1), \end{aligned} \quad (24)$$

IMM outputs