

Flexible Distribution State Estimation System

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Technology Summary

The developed flexible distribution state estimation platform consists of a time-series analysis-based data fusion engine, a distribution system state estimator, and the corresponding output analysis and visualization functions. The data fusion engine will be responsible for performing data pre-processing to regulate the multi-channel data to a standardized input format for distribution system state estimator. In the state estimator, we have *topology identification*, *kernel-driven estimation*, *partial measurement recovery tool* to ensure the estimation accuracy. Finally, the estimated results will be generated and outputted with visualization options.

Key Algorithm - DSES

Algorithm 1 Kernel-Driven Estimation

- 1 Get i^{th} sampled data tuple $x_i = (u_i, a_i, o_i) \rightarrow$ voltage, angle, other;
- 2 Compute the distance d_i between x_i and x_{i-1} ;
- 3 Compute the distance d_u between $g_{i-1}(x_i)$ and u_i, a_i ;
- 4 if $d_u > \varepsilon_u$ or $d_i > \varepsilon_d$:

Construct $\Phi_i^T \Phi_i$ using $[\Phi_i^T \Phi_i]_{m,n} = k(x_m, x_n)$, where $k(\cdot)$ is the kernel function;

Compute $z_i = \mathbf{O}_{i-1} [\Phi_i^T \Phi_i]_{1:i-1,i}$

Compute $r_i = \alpha_d + k(x_i, x_i) - z_i^T [\Phi_i^T \Phi_i]_{1:i-1,i}$

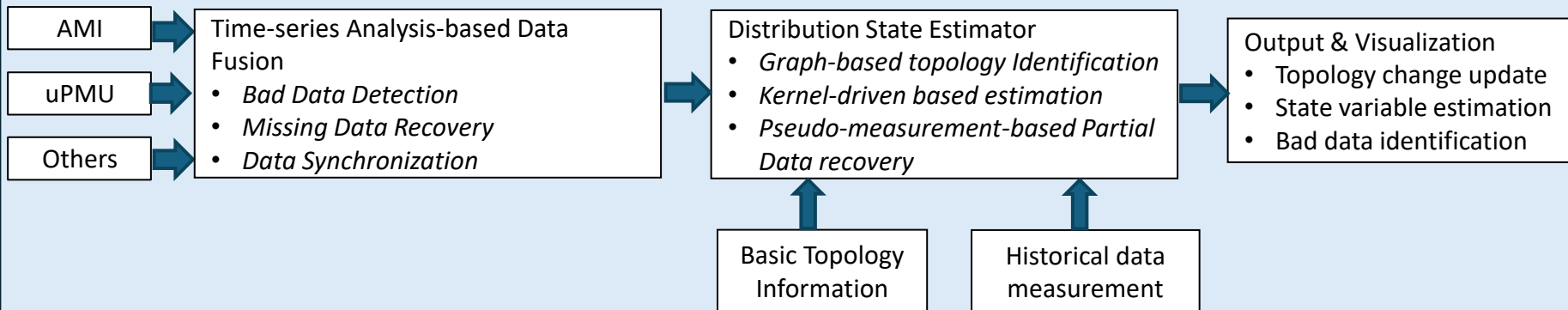
Update $\mathbf{O}_i = r_i^{-1} \begin{bmatrix} \mathbf{O}_{i-1} r_i + z_i z_i^T & -z_i \\ -z_i^T & 1 \end{bmatrix}$

Update weight vector $\mathbf{a}_{j,i} = \begin{bmatrix} \mathbf{a}_{j,i-1} - z_i r_i^{-1} e_i \\ r_i^{-1} e_i \end{bmatrix}$

- 5 Output $y = A_i K(x_i)$ where $K(x_i) = [k(x_i, x_j)] \forall t \leq i$

- 6 Remove $\mathbf{a}_{j,t}$, and $k(x_{j,t}, x)$ when $\|\mathbf{a}_{j,t}\| < \varepsilon_a, t \leq i, \forall j$

Main Structure



Key Personnel/Organizations

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