

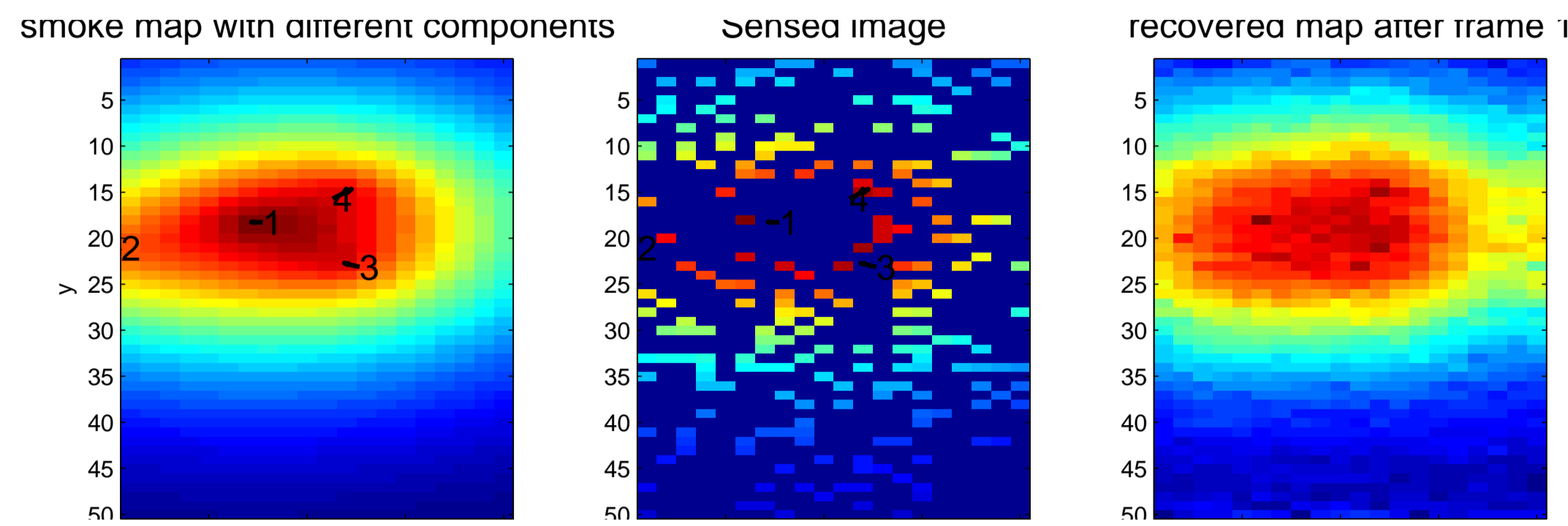
# ADAPTIVE RANDOM SENSING NETWORKS FOR MONITORING TIME-VARYING FIELDS

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## Random Access Compressed Sensing



$$y = R\Psi v + z$$

- Assumption of sparsity in spatial frequency
- Sample at least  $N_s$  sensors uniformly from the sensor field
- Assumption that the field is stationary ( high coherence time )

## Time-Varying Fields

### Parameters

- Inherent coherence time of the field :  $T_{coh}$
- Sensing Time for RACS :  $T$

Undersensing ( $T > T_{coh}$ )

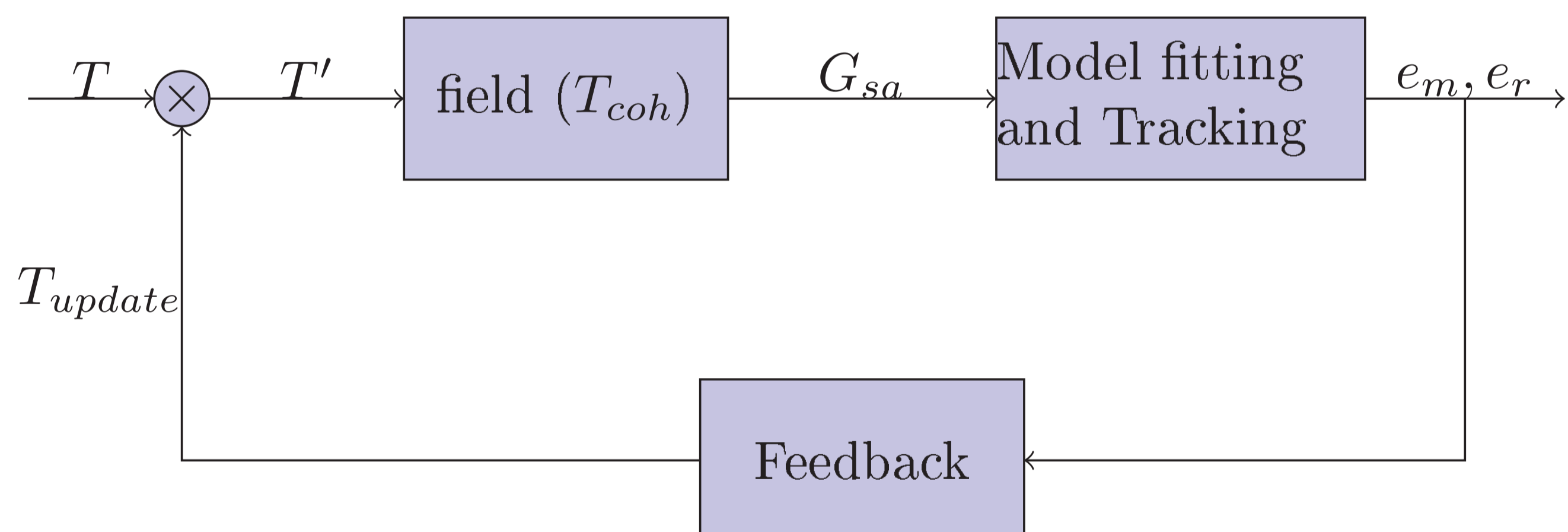
- Blurring
- Need to sense faster

Oversensing ( $T < T_{coh}$ )

- Energy wasted
- Slow down sensing rate

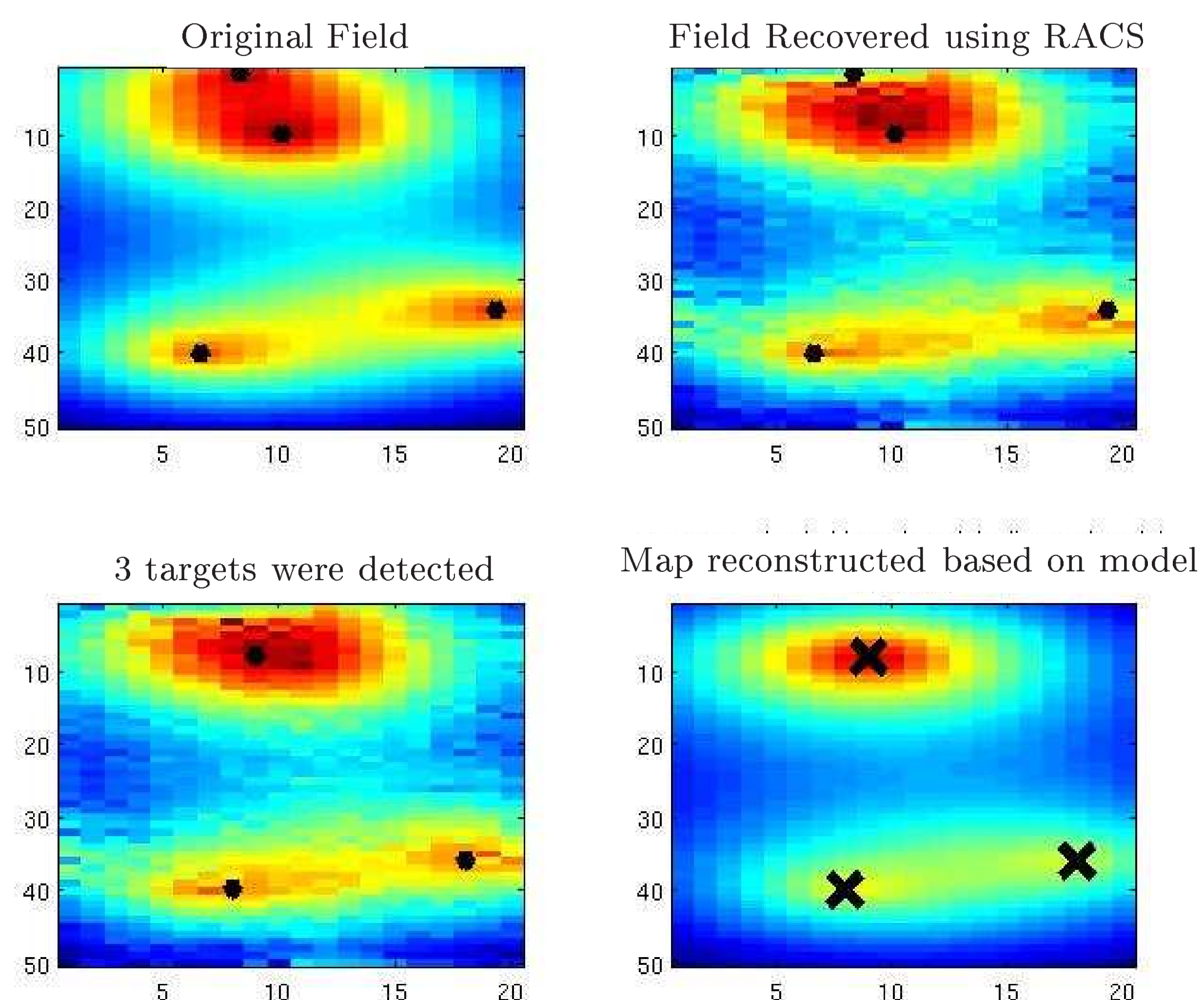
Tradeoff between accuracy and energy efficiency

## Adaptive RACS



$G_{sa}$  : Map reconstructed using sparse approximation  
 $e_m, e_r$  : Motion and reconstruction based feedback errors

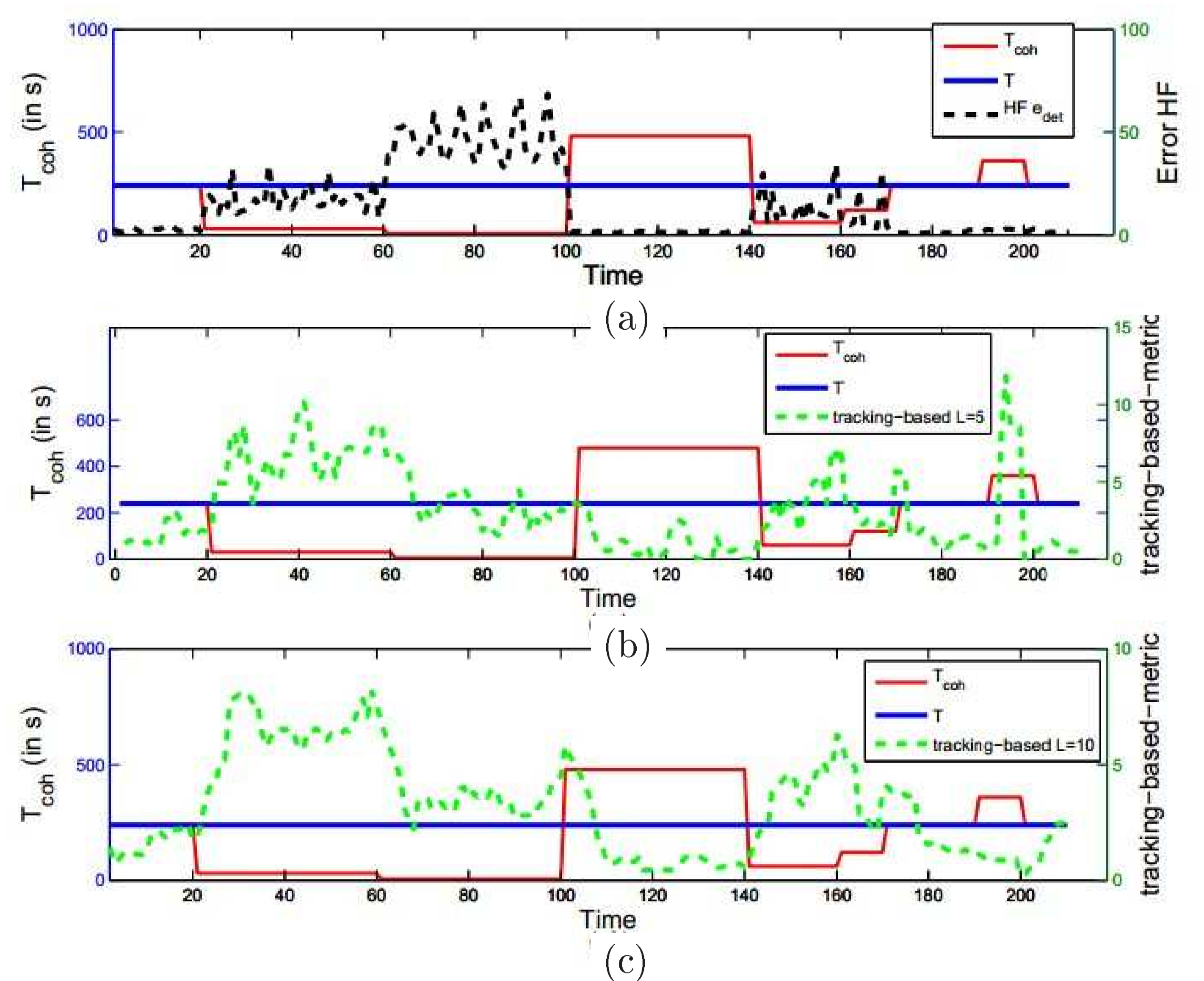
## Tracking and Model fitting Simulation



## Error metrics

- **Reliability of reconstruction**
  - Target Detection (Window based gradient ascent method)
  - Estimate parameters and reconstruct field
  - Model fitting error (Non-linear least squares)
- **Average minimum velocity over past  $L$  frames**
  - The same target may not be detected consistently
  - Dynamic programming based tracking of the slowest target

## Open Loop Operation



## Dual Threshold Feedback

$e_m < th_m$      $e_r > th_r$   
**Oversensing**    **Stable Region**    **Undersensing**

### Control Feedback Rules

$e_m < th_m$ only	$e_m > th_m$ $e_r < th_r$	$e_m < th_m$ $e_r > th_r$	$e_r > th_r$ only
$T \uparrow$	Narrow	Widen	$T \downarrow$

## Closed Loop Control

