EKF - SLAM Based Navigation System for an AUV

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Outline

- Underwater Navigation systems

- SLAM

- SLAM Applications

- Results

- Conclusions

- Future work

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Underwater Navigation Systems

- Long Baseline (LBL)

- Ultra-Short Baseline (USBL)

- Doppler Navigation

- Inertial Navigation (IMUs)

- Global Positioning System (GPS) – near surface missions

- Terrain based navigation (using priori maps)

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Simultaneous Localisation and Mapping (SLAM)

- Is it possible for a mobile robot, starting with no prior information, to move through an environment build a map and concurrently localise within the map?

Benefits of SLAM

- Little initial preparations – no infrastructure to install

- Vehicle's operation not confined to an area

- No priori maps

- No need for GPS

- Reduced costs (no infrastructure required)

- Employed in risky areas

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SLAM Applications

Undersea

Underground

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Models

Control noise   Process noise

- Kinematic model $\longrightarrow$ $X_v(k) = f(X_v(k-1), u_n(k) + \gamma_u(k)) + \gamma_f(k)$

Vehicle pose   Control input

Range - bearing

- Observation model $\longrightarrow$ $z(k) = h(X_v, x_i, y_i) = \begin{bmatrix} r_i \\ \theta_i \end{bmatrix} + \gamma_h(k)$

Vehicle position   Feature position   observation noise

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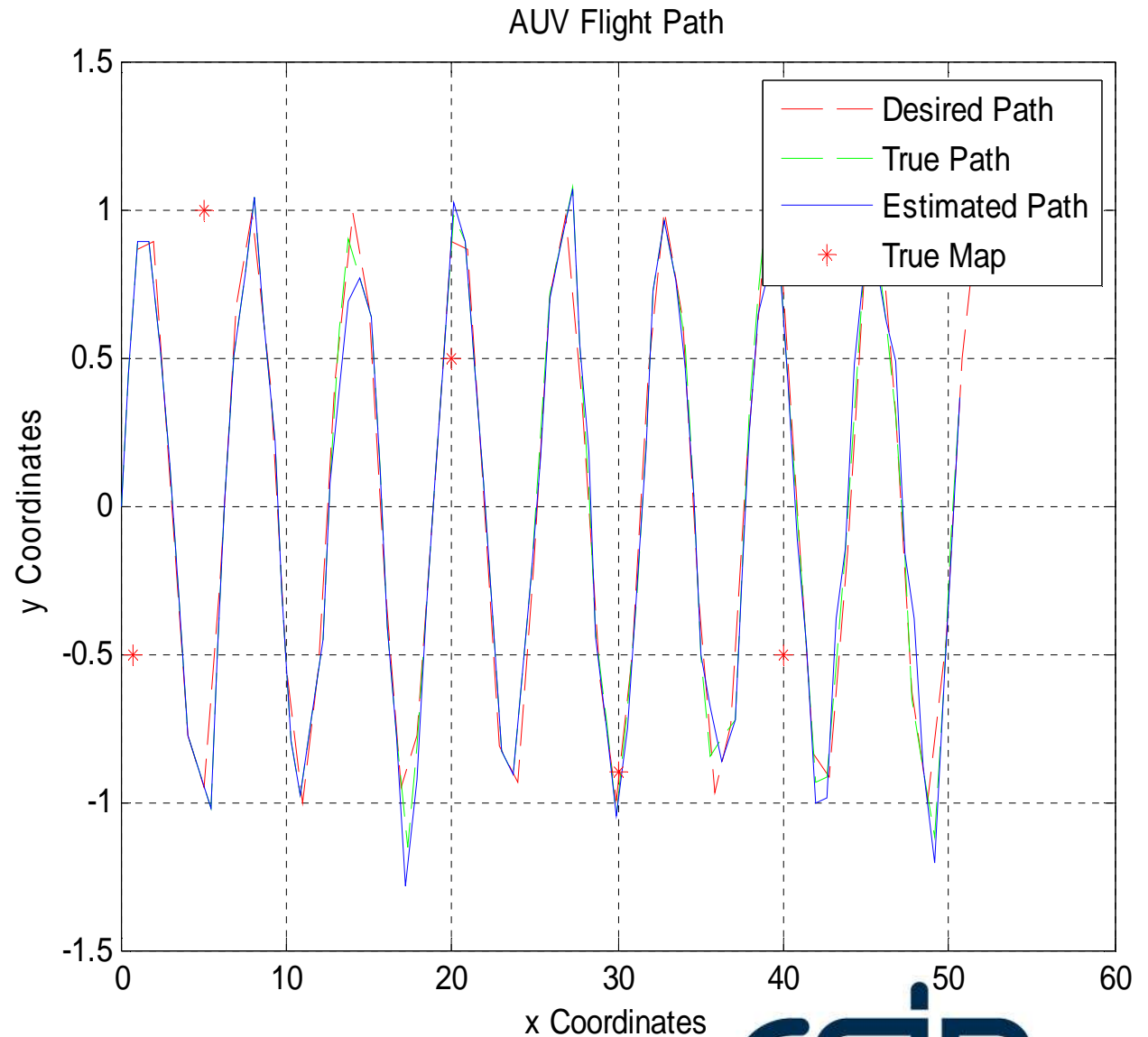*our future through science*

Slide 7

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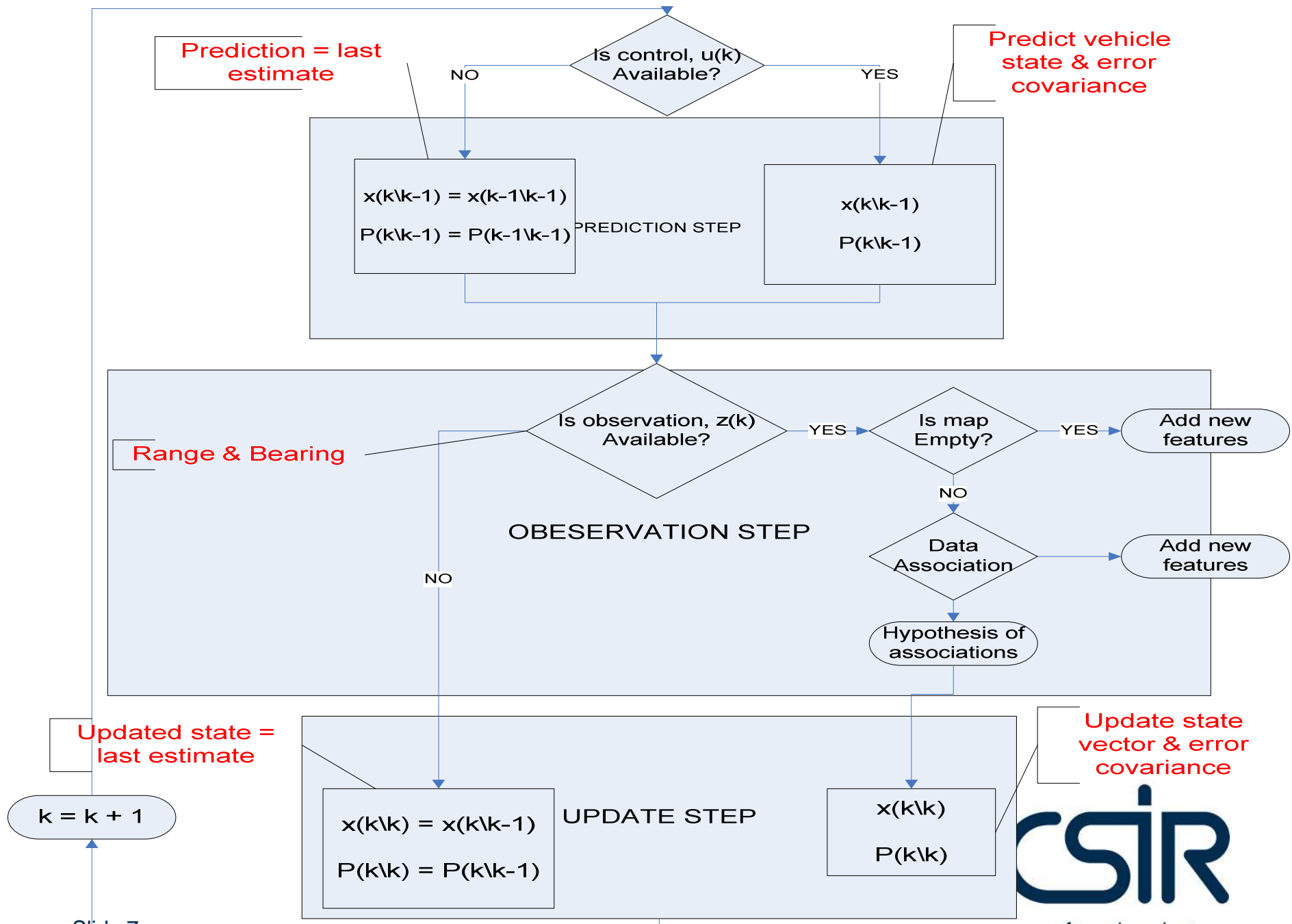
Results analysis

- Path-defined by waypoints

- A feature randomly observed

  Assume

- Obstacle avoidance

- Control to drive actuators

AUV Flight Path

Legend:
- Desired Path
- True Path
- Estimated Path
- True Map

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Actual errors
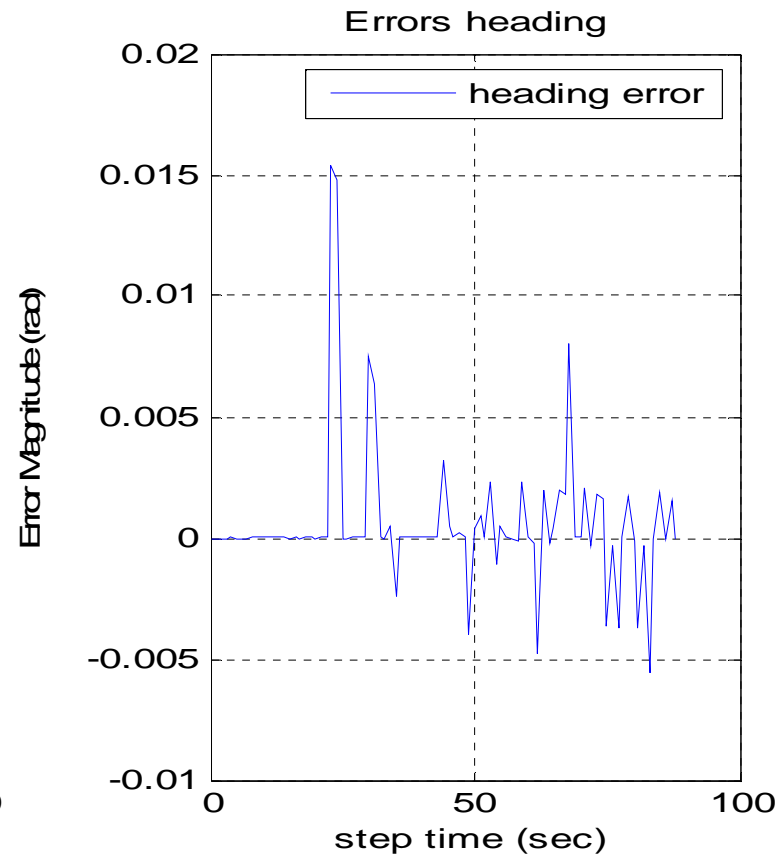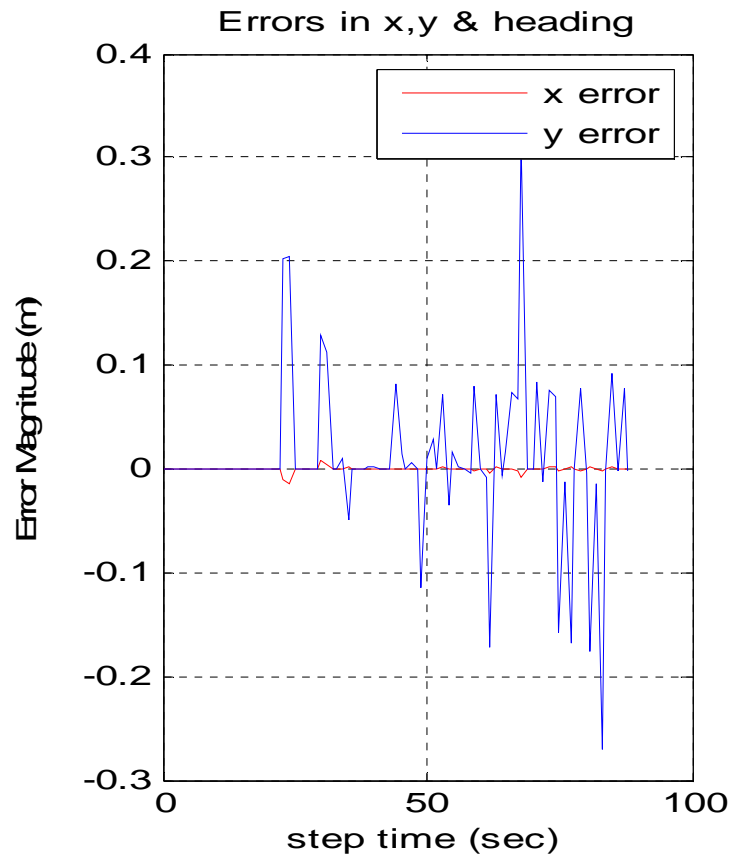
- Hypothesis: Zero mean & white

- By inspection: Results are reasonable

Conclusions & Future work

- Through simulation: vehicle able to perform localisation & mapping concurrently

- Results are reasonable although filter not well tuned

- Future work

  - Data association problem

  - Analysis of filter performance

  - Filter tuning

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THANK YOU