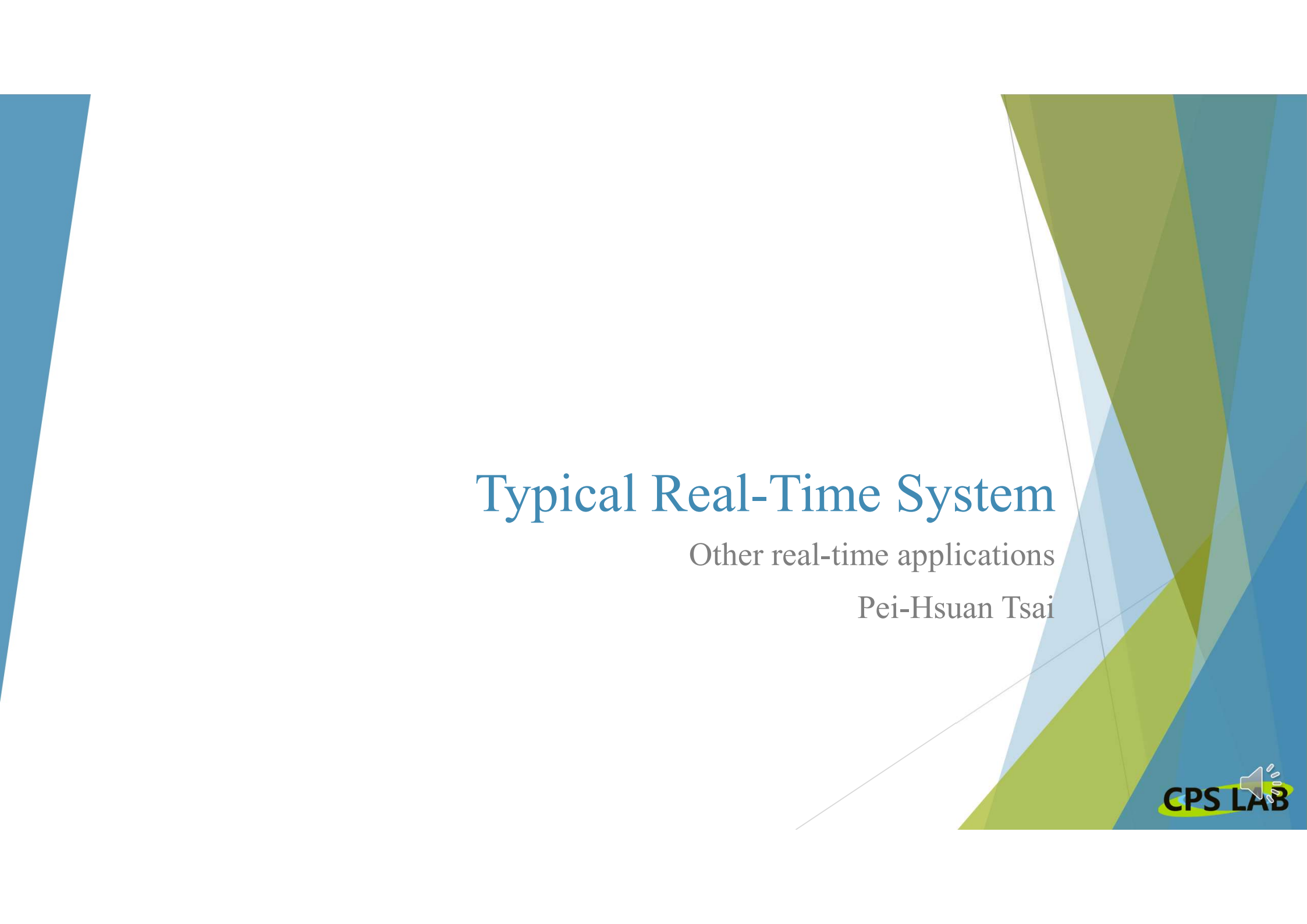
Typical Real-Time System

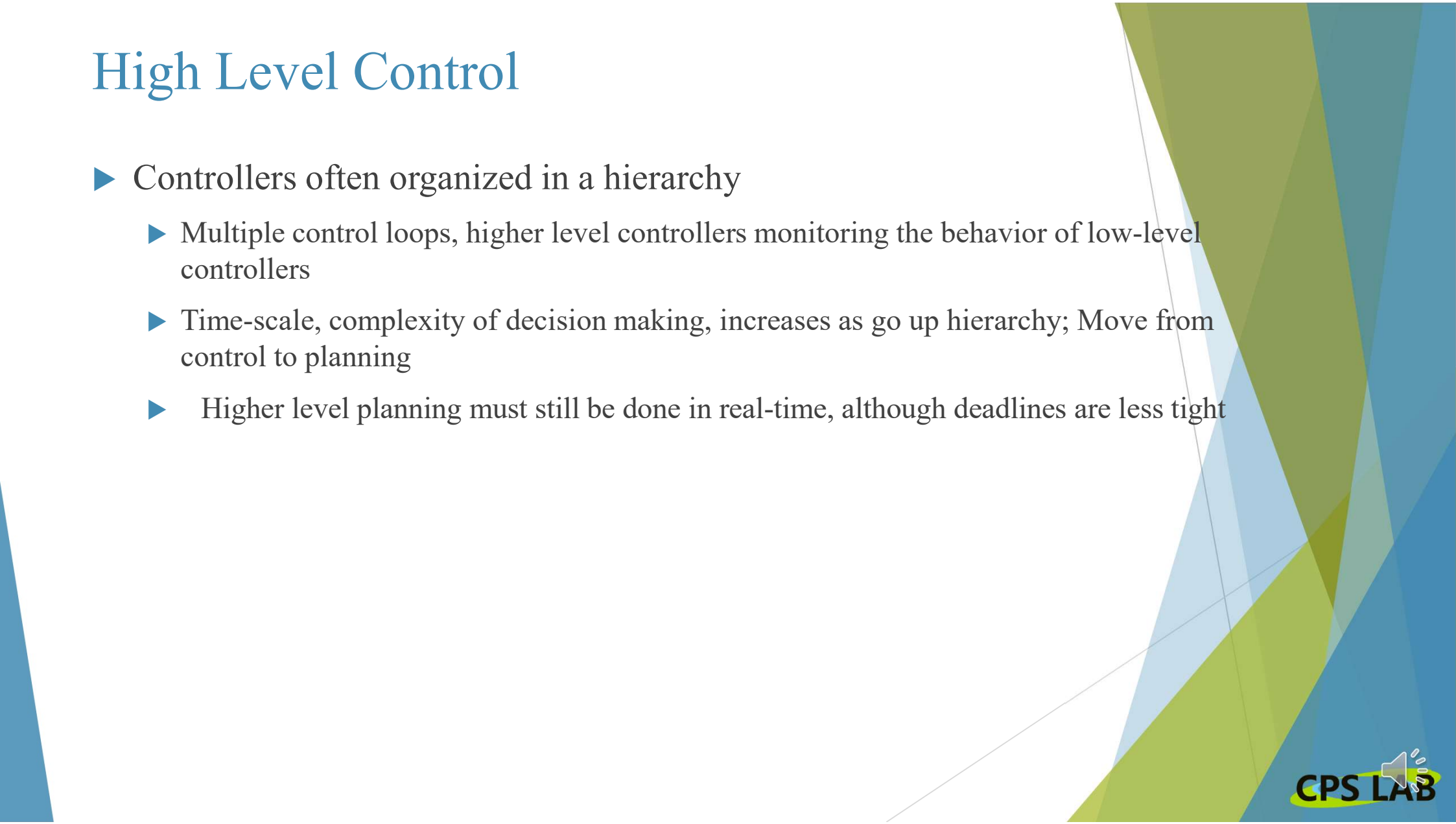
Other real-time applications

Pei-Hsuan Tsai



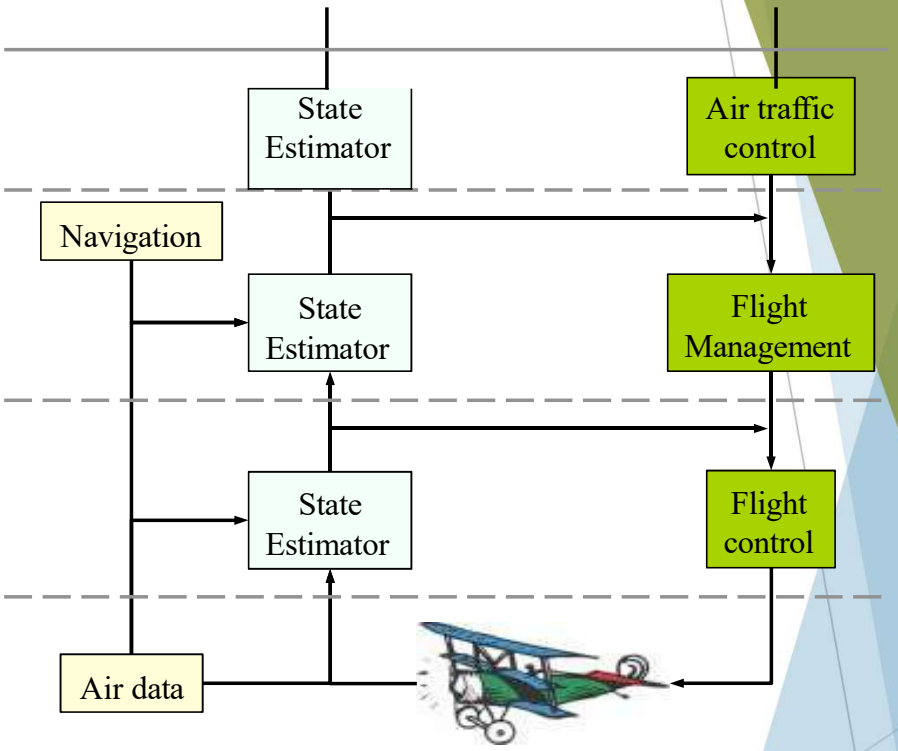
High Level Control

- Controllers often organized in a hierarchy
  - Multiple control loops, higher level controllers monitoring the behavior of low-level controllers
  - Time-scale, complexity of decision making, increases as go up hierarchy; Move from control to planning
  - Higher level planning must still be done in real-time, although deadlines are less tight



Example of Control Hierarchy

- Air Traffic Control (ATC) system is the highest level.
  - Assign the arrival times to each aircraft.
  - A command and control system
  - Monitor aircraft in its coverage area and the environment (weather condition)
  - Generate and present the information needed by the operators (the air traffic controllers)



The hierarchy of flight control, avionics and air traffic control system.

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An architecture of air traffic control system

https://www.youtube.com/watch?v=jQmJq-Ww7Y8

- The ATC system gathers information on the "state" of each aircraft via one or more active radars.
- State variables: identifier, position, altitude, heading and so on.
- Such a radar interrogates each aircraft periodically.
- ATC system processes messages from aircraft and stores the state information this obtained in a database.
- A surveillance system continuously analyzes the scenario and alerts the operators whenever its detects any potential hazard.

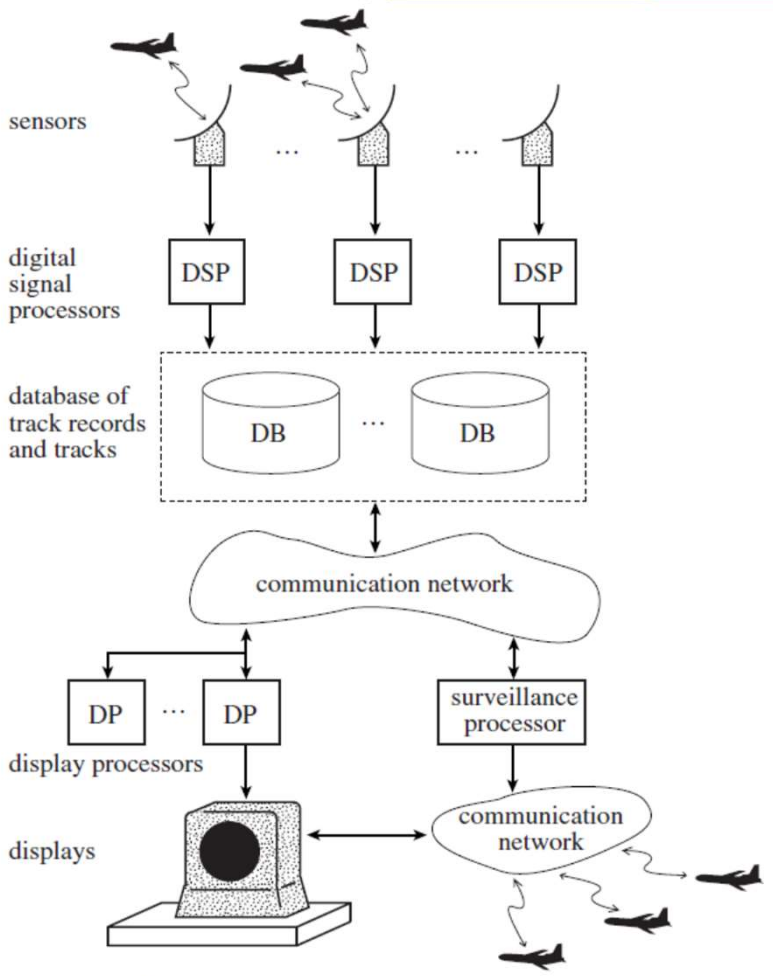

FIGURE 1–5 An architecture of air traffic control system.

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Signal Processing- Radar System

- Track record: position and velocity of the object.
- Time required for signal processing is dominated by the time required to produce the Fourier transforms which is nearly deterministic.
- 10^3 to 10^5 multiplications and additions to generate a Fourier transform.

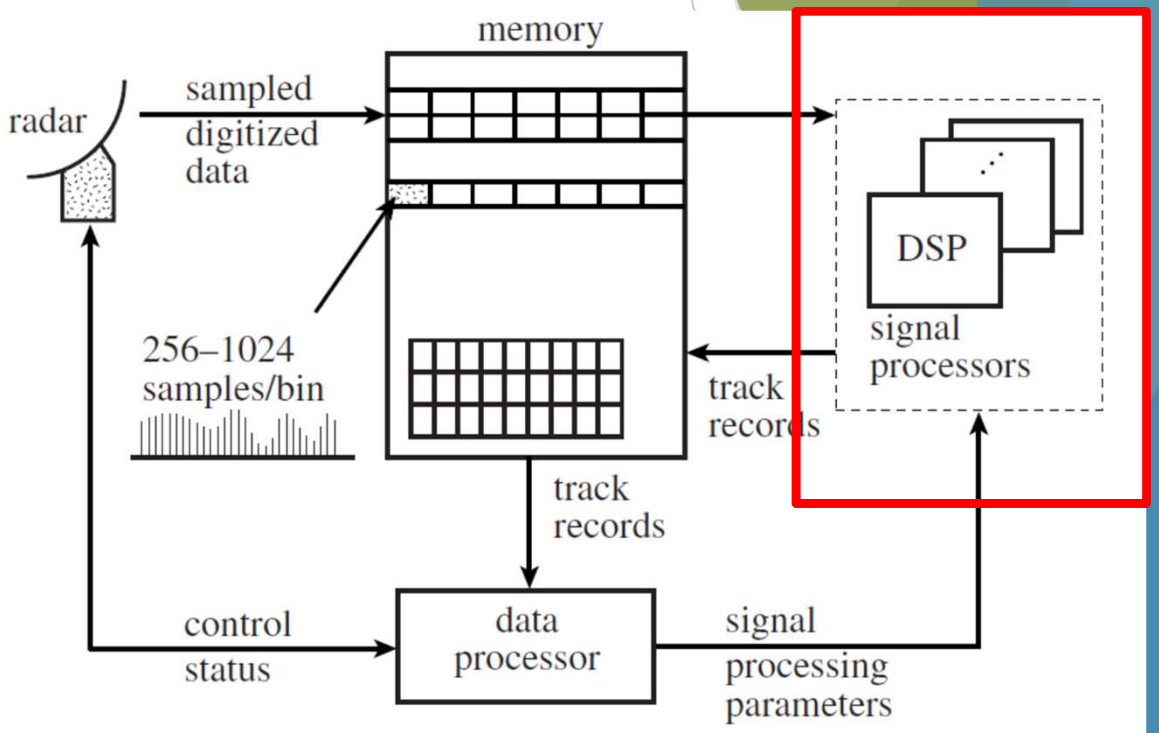

FIGURE 1–6 Radar signal processing and tracking system.

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Data processor : Tracker

1. Gating
2. Data association

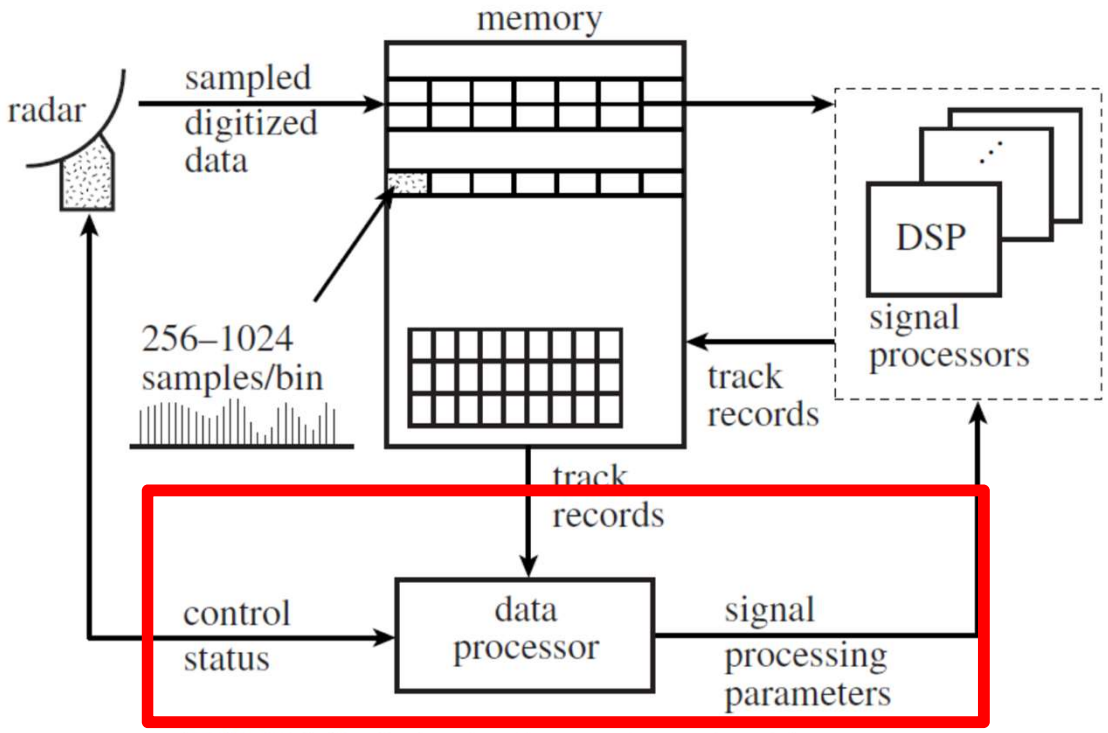

FIGURE 1–6 Radar signal processing and tracking system.

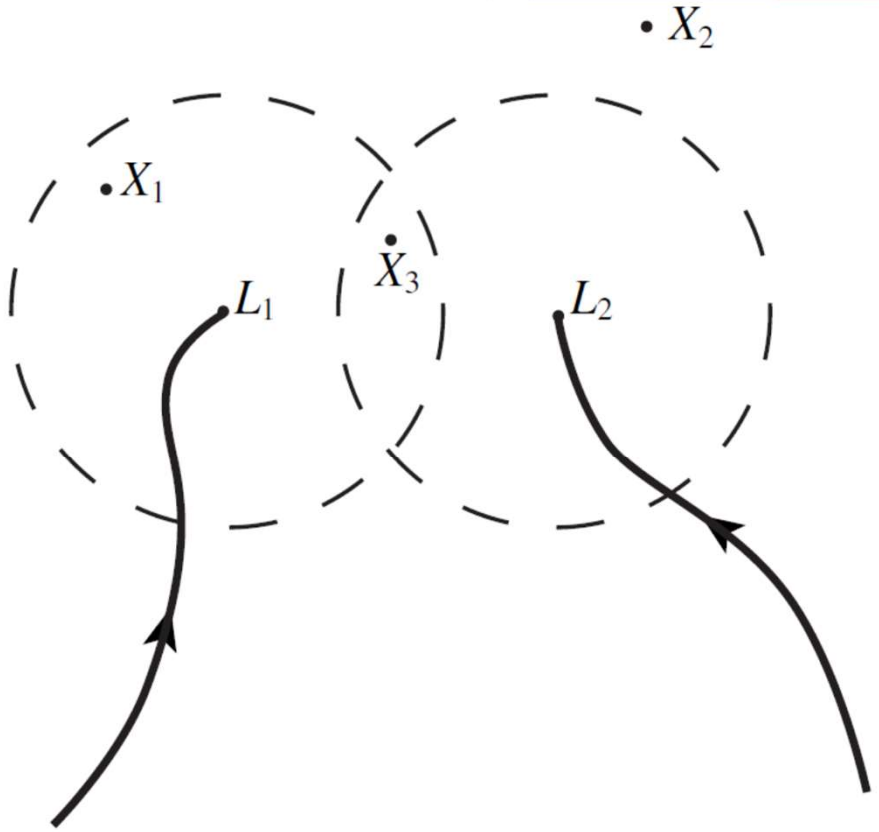

FIGURE 1–7 Gating process.

Real-Time Database

- Ex: Stock price quotation system、track record database、real-time file database.
- Real-world object
  - Data object (image object)
  - Example: aircraft
  - Attributes of aircraft image object : position and heading of aircraft.

Telephony and multimedia

- Video streaming, audio streaming, images, graphics and text.
- MPEG Compression:
  - Motion estimation
  - Discrete Cosine Transform and Encoding
  - Decompression
- Quality of multimedia
  - Video: frame rate and resolution
  - Audio: sampling rate and granularity
  - Synchronization: lip (video and audio) synchronization