SIGNAL PROCESSING ALGORITHMS IN RTS (QNX APPLICATION)

- Most signal processing applications have some kind of real-time requirements.We focus here on those whose response times must be under a few milliseconds to a few seconds. Examples are digital filtering, video and voice compressing/decompression, and radar signal processing . Typically, a real-time signal processing application computes in each sampling period one or more outputs. Each output x(k) is a weighted sum of n inputs y(i)'s:

$$x(k) = \sum_{i=1}^{n} a(k, i) y(i)$$

- In the simplest case, the weights, a(k, i)'s, are known and fixed.8 In essence, this computation transforms the given representation of an object (e.g., a voice, an image or a radar signal) in terms of the inputs, y(i)'s, into another representation in terms of the outputs, x(k)'s. Different sets of weights, a(k, i)'s, give different kinds of transforms. This expression that the time required to produce an output is O(n).

- **Radar System:** A signal processing application is typically a part of a larger system. As an example, Figure 1–6 shows a block diagram of a (passive) radar signal processing and tracking system. The system consists of an Input/Output (I/O) subsystem that samples and digitizes the echo signal from the radar and places the sampled values in a shared memory.

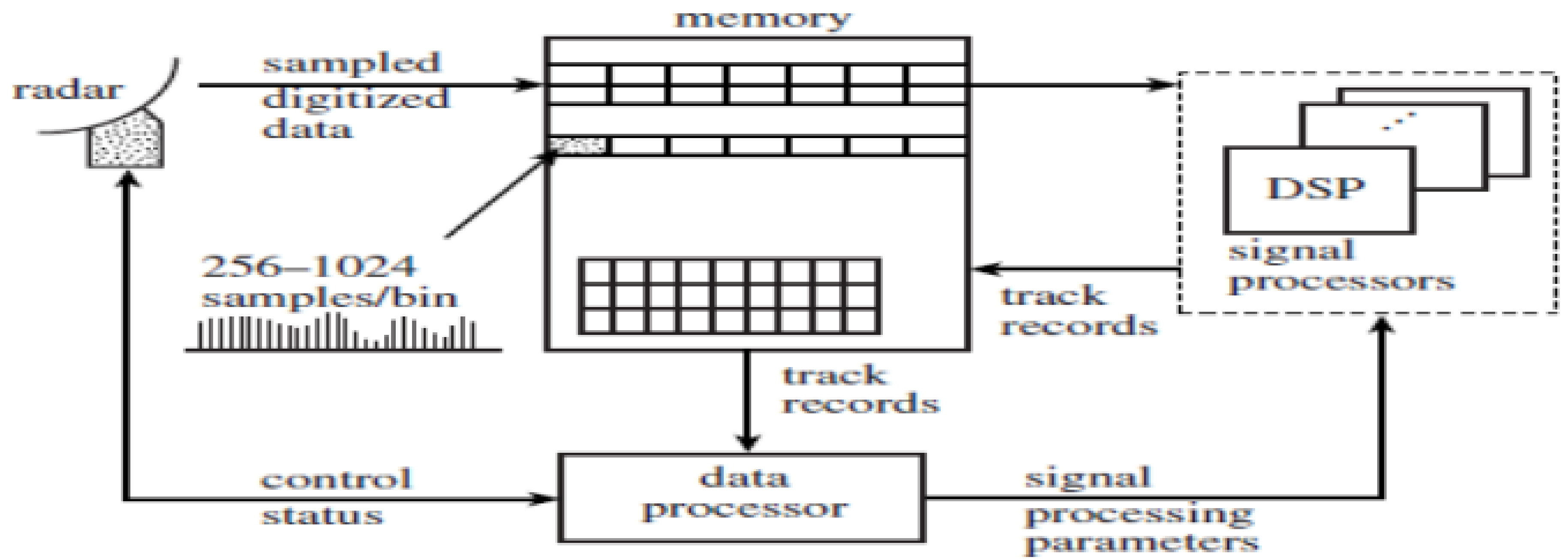


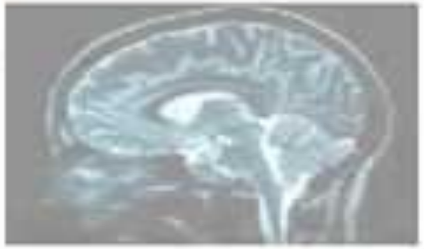
FIGURE 1–6 Radar signal processing and tracking system.

- An array of digital signal processors processes these sampled values. The data thus produced are analyzed by one or more data processors, which not only interface with the display system, but also generate commands to control the radar and select parameters to be used by signal processors in the next cycle of data collection and analysis.
- **Radar Signal Processing:** To search for objects of interest in its coverage area, the radar scans the area by pointing its antenna in one direction at a time. During the time the antenna dwells in a direction, it first sends a short radio frequency pulse. It then collects and examines the echo signal returning to the antenna.
- The echo signal consists solely of background noise if the transmitted pulse does not hit any object. On the other hand, if there is a reflective object (e.g., an airplane or storm cloud) at a distance x meters from the antenna, the echo signal reflected by the object returns to the antenna at approximately 2x/c seconds after the transmitted pulse, where c = 3×108 meters.

- The echo signal collected at this time should be stronger than when there is no reflected signal. If the object is moving, the frequency of the reflected signal is no longer equal to that of the transmitted pulse.
- **Tracking**: track record on a nonexisting object is called a false return. An application that examines all the track records in order to sort out false returns from real ones and update the trajectories of detected objects is called a tracker.
- **Gating.** Typically, tracking is carried out in two steps: gating and data association Gating is the process of putting each measured value into one of two categories depending on whether it an or cannot be tentatively assigned to one or more established trajectories.
- **Data Association.** The tracking process completes if, after gating, every measured value is assigned to at most one trajectory and every trajectory is assigned at most one measured value.

- **Complexity and Timing Requirements.** In contrast to signal processing, the amounts of processor time and memory space required by the tracker are data dependent and can vary widely.When there are n established trajectories and m measured values, the time complexity of gating is O(nm logm).

Signal-Processing Applications



- Consumer electronics
  - HDTV, cell phones, cameras, ...
- Transportation
  - GPS, engine control, airplane tracking, ...
- Medical
  - Imaging, monitoring (EEG, ECG), ...
- Military
  - Target tracking, surveillance, ...
- Remote sensing
  - Astronomy, climate monitoring, weather forecasting, ...

THANKS FOR YOUR ATTENTION