5.7 ACQUISITION

A tracking radar must first find and acquire its target before it can operate as a tracker. Therefore it is usually necessary for the radar to scan an angular sector in which the presence of the target is suspected. Most tracking radars employ a narrow pencil-beam antenna. Searching a volume in space for an aircraft target with a narrow pencil beam would be somewhat analogous to searching for a fly in a darkened auditorium with a flashlight. It must be done with some care if the entire volume is to be covered uniformly and efficiently. Examples of the common types of scanning patterns employed with pencil-beam antennas are illustrated in Fig. 5.18.

In the *helical* scan, the antenna is continuously rotated in azimuth while it is simultaneously raised or lowered in elevation. It traces a helix in space. Helical scanning was employed for the search mode of the SCR-584 fire-control radar, developed during World War II for the aiming of antiaircraft-gun batteries.[59] The SCR-584 antenna was rotated at the rate of 6 rpm and covered a 20° elevation angle in 1 min. The *Palmer* scan derives its name from the familiar penmanship exercises of grammar school days. It consists of a rapid circular scan (conical scan) about the axis of the antenna, combined with a linear movement of the axis of rotation. When the axis of rotation is held stationary, the Palmer scan reduces to the *conical*

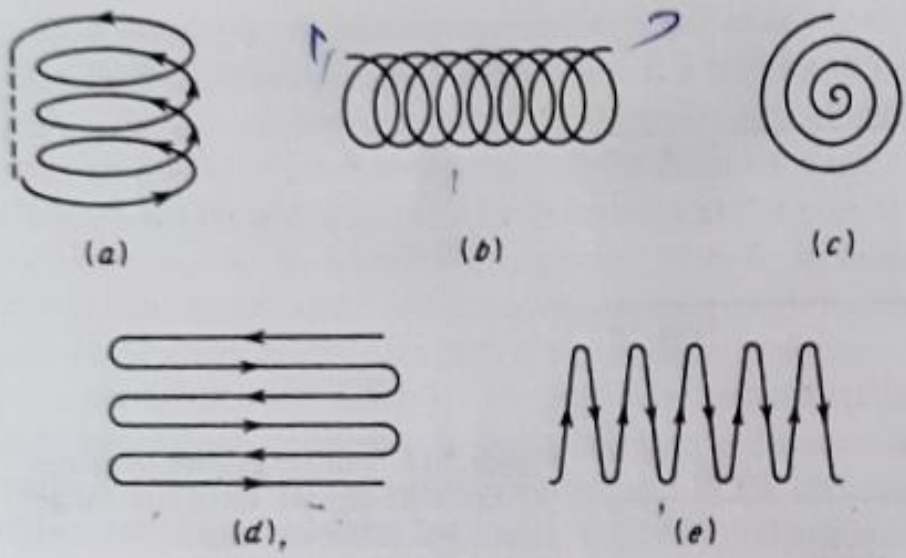

Figure 5.18 Examples of acquisition search patterns. (*a*) Trace of helical scanning beam; (*b*) Palmer scan; (*c*) spiral scan; (*d*) raster, or TV, scan; (*e*) nodding scan. The raster scan is sometimes called an *n*-bar scan, where *n* is the number of horizontal rows.

scan. Because of this property, the Palmer scan is sometimes used with conical-scan tracking radars which must operate with a search as well as a track mode since the same mechanisms used to produce conical scanning can also be used for Palmer scanning.[60] Some conical-scan tracking radars increase the squint angle during search in order to reduce the time required to scan a given volume. The conical scan of the SCR-584 was operated during the search mode and was actually a Palmer scan in a helix. In general, conical scan is performed during the search mode of most tracking radars.

The Palmer scan is suited to a search area which is larger in one dimension than another. The *spiral* scan covers an angular search volume with circular symmetry. Both the spiral scan and the Palmer scan suffer from the disadvantage that all parts of the scan volume do not receive the same energy unless the scanning speed is varied during the scan cycle. As a consequence, the number of hits returned from a target when searching with a constant scanning rate depends upon the position of the target within the search area.

The *raster*, or *TV*, scan, unlike the Palmer or the spiral scan, paints the search area in a uniform manner. The raster scan is a simple and convenient means for searching a limited sector, rectangular in shape. Similar to the raster scan is the *nodding* scan produced by oscillating the antenna beam rapidly in elevation and slowly in azimuth. Although it may be employed to cover a limited sector—as does the raster scan—nodding scan may also be used to obtain hemispherical coverage, that is, elevation angle extending to 90° and the azimuth scan angle to 360°.

The helical scan and the nodding scan can both be used to obtain hemispheric coverage with a pencil beam. The nodding scan is also used with height-finding radars. The Palmer, spiral, and raster scans are employed in fire-control tracking radars to assist in the acquisition of the target when the search sector is of limited extent.

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