



IEEE Standard for Radar Definitions

STANDARDS

IEEE Aerospace and Electronic Systems Society

Developed by the
Radar Systems Panel

IEEE Std 686™-2024
(Revision of IEEE Std 686-2017)



IEEE Standard for Radar Definitions

Developed by the

Radar Systems Panel
of the
IEEE Aerospace and Electronic Systems Society

Approved 26 September 2024

IEEE SA Standards Board

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Abstract: The promotion of clarity and consistency in the use of radar terminology is the purpose of the definitions provided in this guide. The consensus of a panel of radar experts is represented in the definitions herein.

Keywords: IEEE 686™, radar, terminology

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Introduction

This introduction is not part of IEEE Std 686-2024, IEEE Standard for Radar Definitions.

Originally, radar definitions were included in IEEE Std 172TM-1971 [B3].⁶ In 1974, the Radar Systems Panel of the IEEE Aerospace and Electronic Systems Society set out to create a separate standard devoted to radar definitions. The result was the first edition of this standard, IEEE Std 686TM-1977. To avoid overlap and conflict with the radar definitions existing in IEEE Std 172-1971, the IEEE Standards Board allowed only new terms not already in that standard to be included in IEEE Std 686-1977.

The second edition, IEEE Std 686-1982, included terms formerly found in IEEE Std 172-1971, with the exception of a few terms that are common to both fields, and new and updated terms. IEEE Std 686-1982 updated, added, and/or deleted standard radar definitions. The third edition, IEEE Std 686TM-1990; the fourth edition, IEEE Std 686TM-1997; the fifth edition, IEEE Std 686TM-2008; the sixth edition, IEEE Std 686TM-2017, each added and/or deleted standard radar definitions.

IEEE Std 686TM-2024 adds new terms and revises others. Also noted is the obsolescence of IEEE Std 1672TM-2006, IEEE Standard for Ultrawideband Radar Definitions, and references to it in IEEE Std 686-2024 have been removed.

The work of preparing the drafts of this standard, integrating all comments, resolving differences, and coordinating this standard with other standards was accomplished by the Working Group for the Radar Systems Panel of the IEEE Aerospace and Electronic Systems Society.

⁶The numbers in brackets correspond to those of the bibliography in Annex A.

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IEEE Standard for Radar Definitions

1. Overview

1.1 Scope

This standard is devoted to providing radar definitions. The standard includes terms formerly found in IEEE Std 172™-1971 [B4] and [IEEE Std 172-1983 \[B5 B3\] and \[B4\]](#), with the exception of a few terms that are common in both fields⁷ and new and updated terms.³ IEEE Std 172 was withdrawn in 1993. As radar technology and literature evolve, new terms will be added² and obsolete terms deleted.⁴

1.2 Purpose

This standard is published for the purpose of promoting clarity and consistency in the use of radar terminology. The definitions represent the consensus of a panel of radar experts. The purpose of the revision is to add new terms, revise others, and delete a number of obsolete terms that no longer appear in radar literature or usage.

1.3 Word usage

The word *shall* indicates mandatory requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted (*shall* equals *is required to*).^{7,8}

The word *should* indicates that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required (*should* equals *is recommended that*).

The word *may* is used to indicate a course of action permissible within the limits of the standard (*may* equals *is permitted to*).

⁷The use of the word *must* is deprecated and cannot be used when stating mandatory requirements; *must* is used only to describe unavoidable situations.

⁸The use of *will* is deprecated and cannot be used when stating mandatory requirements; *will* is only used in statements of fact.

³~~The numbers in brackets correspond to those of the bibliography in Annex A.~~

The word *can* is used for statements of possibility and capability, whether material, physical, or causal (*can* equals *is able to*).

2. Definitions, acronyms, and abbreviations

2.1 Definitions

For the purposes of this document, the following terms and definitions apply. The *IEEE Standards Dictionary Online* should be consulted for terms not defined in this clause. ^{2 5}

NOTE—The abbreviations capitalized in this standard are in accordance with prevailing radar usage. Lowercase abbreviations are an acceptable alternative, provided they are used in a consistent manner. ^{10,11 6}

active electronically scanned array (AESA): A phased array antenna consisting of a number of radiating elements each having signals that may be independently controlled to form one or more beams in desired direction(s), specifically when an independent solid-state amplifier is located at each element to achieve the array's transmit operation. See: **phased array**.

adaptive radar: A radar system that adapts its processing and control to improve the performance achievement of a desired function.

aided tracking: A tracking technique in which the manual correction of the tracking error corrects the rate of motion of the tracking mechanism.

airborne early warning (AEW) radar: Describing an early-warning or air-surveillance radar carried by an airborne or spaceborne vehicle. See ~~also:~~ **early-warning radar**.

^{2 4}IEEE Standards Dictionary Online is available at: <http://dictionary.ieee.org>. An IEEE account is required for access to the dictionary, and one can be created at no charge on the dictionary sign-in page.

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^{11 5}Notes in text, tables, and figures of a standard are given for information only and do not contain requirements needed to implement this standard.

airborne moving-target indication (AMTI) radar: ~~A~~ [An](#) moving-target indication (MTI) radar flown in an aircraft or other moving platform with corrections applied for the effects of platform motion, which include the changing clutter Doppler frequency and the spread of the clutter Doppler spectrum. *See also:* **airborne moving-target indication (~~AMTI~~) radar, displaced phase center antenna, ~~;~~ space-time adaptive processing, ~~;~~ time-averaged-clutter coherent airborne radar.**

airborne-intercept ([ABI](#) ~~AI~~) radar: A fire-control radar for use in interceptor aircraft.

airport surface detection equipment (ASDE): A high-resolution radar usually located on the airport control tower or other high point and used for observation of the positions of aircraft and other vehicles on the surface of an airport.

airport-surveillance radar (ASR): A medium-range (e.g., 100 km) surveillance radar used to [monitor](#) ~~control~~ aircraft in the vicinity of an airport.

air-route-surveillance radar (ARSR): A long-range (e.g., 350 km) surveillance radar used to [monitor](#) ~~control~~ aircraft on airways beyond the coverage of airport-surveillance radar (ASR).

air-surveillance radar: A surveillance radar whose function is to detect and track aircraft over a volume of space.

alert-confirm detection: A technique in which initial detection is followed quickly with a confirm dwell waveform optimized to the range, angle, and sometimes radial velocity of the alert detection. *See also:* **two-step sequential detection.**

ambiguity function: The squared magnitude $|X(\tau, f_d)|^2$ of the function that describes the response of a radar receiver to point targets displaced in range delay (τ) and Doppler frequency (f_d) from a reference position, where $|X(0,0)|$ is normalized to unity. This [function](#) ~~term~~ is expressed mathematically as follows:

$$\chi(\tau, f_d) = \int_{-\infty}^{\infty} u(t) u^*(t + \tau) \exp(j2\pi f_d t) dt \quad (1)$$

[\(New\)](#)

$$\chi(\tau, f_d) = \int_{-\infty}^{\infty} u(t) u^*(t + \tau) \exp(2\pi i f_d t) dt$$

~~(Deleted)~~

where

$u(t)$ is the transmitted waveform, suitably normalized

$u^*(t)$ is the complex conjugate of $u(t)$

positive τ is indicating a target beyond the reference delay

positive f_d is indicating an approaching target

[For the variables, the sign convention of Radar Handbook \[B8\] is followed here.](#) The ambiguity function is used to examine the suitability of radar waveforms for achieving accuracy, resolution, freedom from ambiguities, and reduction of unwanted clutter. [It is noted that this describes the narrowband ambiguity function, and there is a wideband ambiguity function that isn't mentioned much in radar systems. See: cross-ambiguity function.](#)

~~NOTE—See IEEE Std 1672 [B6].^{7,8}~~

amplitude fluctuations: ~~See: target fluctuation.~~

amplitude noise: Used variously to describe target fluctuation and scintillation error.

amplitude-comparison monopulse: A form of monopulse in which the angular deviation of the target from the antenna axis is measured as the amplitude ratio of the target as received by two antenna patterns. The patterns may be a pair of beams displaced on opposite sides of the antenna axis, or a difference-channel beam having odd symmetry about the axis and a sum beam having even symmetry. In the latter case the ratio may have positive and negative values (0° or 180° phase shift, or in some cases $+90^\circ$ and -90°). Distinguished from phase-comparison monopulse, in which the relative phase of the two patterns carries the information on target displacement. ~~See also: phase-comparison monopulse, multi-channel amplitude-comparison monopulse.~~

angel (or angel echo): A radar echo caused by birds, insects, and atmospheric clear-air turbulence not usually visible to the eye. Often a term applied to any unknown radar echo that does not appear to be related to conventional targets.

angle noise: The noise-like variation in the apparent angle of arrival of a signal received from a target, caused by changes in phase and amplitude of multiple, unresolved target-scattering sources. Includes both glint and scintillation errors. ~~See also: glint, scintillation error.~~

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angular resolution: The ability to distinguish between two targets solely by the observation of their angle, usually expressed in terms of the minimum angle separation by which two targets at a given range can be distinguished. The required separation should be specified [as a probability of distinguishing the](#) targets for [a](#) given relative power level at the receiver [and angular separation](#). Equal powers are often assumed, but where resolution of targets of different powers is important it may be necessary to specify the separation at two or more power ratios. The concept of angular resolution should not be confused with angular measurement accuracy, which for a single target is a function of antenna beamwidth and signal-to-noise ratio.

antenna: Subsystem for efficient coupling of electromagnetic radiation into or from the propagation medium.

[NOTE—See IEEE Std 145™-2013 \[B3\].](#)

antenna-pattern loss: [Syn](#) ~~See:~~ beamshape loss.

antisubmarine warfare (ASW) radar: A radar used in antisubmarine warfare. It includes radars for the detection of submarines and submarine effects as well as radars on ships or aircraft employed in ASW operations to obtain situational awareness of the surface ships and aircraft in the vicinity of ASW operations.

antisurface vessel (ASV) radar: A radar used in airborne maritime surveillance of shipping. ~~Syn:~~
~~anti-sur-face warfare (ASuW) radar.~~ [See also:](#) **antisubmarine warfare (ASW) radar.**

aperture reference point (ARP): The 3-D location of the platform at the center of the synthetic aperture. It is usually expressed in Earth-centered, Earth-fixed₇ (ECEF) coordinates in meters.

area moving target indication ([Area-MTI](#)): A method of MTI based upon amplitude changes in corresponding resolution cells for radar returns obtained at different times.

array antenna: Antenna made up of individual transmitting and receiving elements where beamforming and steering is achieved by control of time or phase delay between elements. [See also:](#)
phased array.

auroral clutter: Clutter from the aurora borealis or aurora australis. Most frequently observed with HF over-the-horizon radars and VHF radars.

automatic detection and tracking (ADT): In a surveillance radar, the computer-based ADT of targets based on target locations obtained from each look. *See also:* **track-while-scan**.

automatic target recognition (ATR): Radar signal and image processing techniques associated with automatic discrimination and identification of targets as opposed to detection processing (including the exploitation of target detection reports or track profiles). However, ATR includes detection processing as an essential or critical first component in the radar signal and image processing chain.

automatic tracking: The process by which targets are detected and tracked by computer-controlled means, rather than a human operator, in which a system employs some feedback mechanism (e.g., a servo or computer) to automatically follow some characteristic of a signal or target, such as range, angle, Doppler frequency, or phase. *See also:* **tracking, tracking radar**.

azimuth: The angle between a horizontal reference direction (usually north) and the horizontal projection of the direction of interest, measured clockwise.

azimuth markers: *See:* **azimuth marks**.

azimuth marks: Calibration marks used on a display for azimuth. ~~*Syn:* azimuth markers.~~

azimuth-stabilized plan-position indicator (PPI): A PPI on which the reference direction remains fixed with respect to the indicator, regardless of the radar platform orientation. [See: azimuth marks.](#)

backscatter: Energy reflected or scattered in a direction opposite to that of the incident wave.

backscatter coefficient: A normalized measure of radar return from a distributed scatterer. For area targets, such as ground or sea clutter, it is defined as the average *monostatic* radar cross section (RCS) per unit surface area. The backscatter coefficient for area targets, often expressed in decibels and denoted by σ^0 , is dimensionless but is sometimes written in units of m^2/m^2 for clarity. For volume scatter, such as that from rain, chaff, or deep snow cover, it is defined as the average monostatic RCS per unit volume and is expressed in units of m^2/m^3 or m^{-1} . The volume backscatter coefficient is often expressed in decibels and denoted by the symbol η or η_v . The backscatter coefficient is sometimes known as *normalized radar reflectivity*.

backscatter cross section: *See:* **radar cross section**.

Barker code: A binary phase code used for pulse compression, in which a long pulse is divided into n subpulses with the phase of each subpulse being 0 or π radians. Barker-coded pulses have the property that after matched filter processing there are $(n - 1)/2$ sidelobes, or $n/2$ for n even, on each side of the main response, each at a peak voltage level $1/n$ relative to the main response. Barker codes exist with $n = 2, 3, 4, 5, 7, 11, 9$, and 13. [See: coded pulse.](#) ~~See also:~~ **coded pulse.**

beacon: *See: radar beacon.*

beacon equation: An equation that gives the maximum detection range of a transponder or secondary radar as a function of system parameters for a given set of conditions. It is the one-way counterpart of the two-way radar equation. [See: Friis transmission equation.](#)

beam: The formation of radiation into a constrained solid angle using an antenna. ~~See also:~~ **antenna.**

beam broadening: The increase in the antenna beamwidth, often as a result of scanning the beam of a phased array off the broadside direction.

beamshape loss: A loss factor included in the radar equation to account for the target not always being at the peak of the radar beam. For scanning search radars, this loss accounts for the use of the peak antenna gain in the radar equation instead of the effective gain that results when the received train of pulses is modulated by the two-way pattern of a scanning antenna. For [a phased-array radar operated in search mode](#) ~~radars~~, this loss accounts for using the peak gain instead of the effective gain that results from the variation of the antenna gain over the search pattern. *Syn:* **antenna-pattern loss.**

bearing: [The angle between the horizontal component of the velocity vector of a moving platform and the horizontal projection of the direction of interest, measured clockwise.](#) *See: azimuth.*

bistatic denial: An electronic protection (EP) method designed to deny a coherent reference to a noncooperative bistatic radar receiver, thus degrading detection performance of the bistatic radar without degrading the performance of the host radar.

bistatic radar: A radar using antennas for transmission and reception at sufficiently different locations that the angles or ranges to the target are significantly different.

bistatic scatter: Energy reflected or scattered in any direction other than the incident direction or opposite to the incident direction (i.e., backscatter).

bistatic-scatter cross section: *See:* **radar cross section.**

bistatic velocity: In bistatic radar, the time derivative of the bistatic range. It is proportional to the Doppler frequency:

$$V = \frac{dR}{dt} = -f_d \lambda \quad (2)$$

(New)

where

R is the bistatic range

f_d is the Doppler frequency

λ is the wavelength

negative V is indicating an approaching target

positive f_d is indicating an approaching target

blind range: A range corresponding to the time delay of an integral multiple of the interpulse period plus a time less than or equal to the transmitted pulse length. A radar usually cannot detect targets at a blind range because of interference by a subsequent transmitted pulse. *See ~~also~~:* **eclipsing.**

blind speed [radar using moving-target indication (MTI)]: Radial velocity of a target with respect to the radar for which the MTI response is approximately zero. In a coherent MTI system using a uniform repetition rate, a blind speed is a radial velocity at which the target changes its distance by one-half wavelength, or a multiple thereof, during each pulse-repetition interval (PRI).

boresighting: The process of aligning the electrical and mechanical axes of a directional antenna system, usually by an optical procedure.

broadside: For a planar or linear array, the direction normal to the array surface; sometimes called the *on-axis direction*.

burnthrough: The process of increasing the radar signal to allow detection in the presence of jamming, for example by increasing pulse energy or decreasing range. *See:* **self-screening range.**

burnthrough range: The range at which a target can be detected in the presence of jamming. *See:* **burnthrough, self-screening range.**

burst: *See:* **pulse burst.**

calibration markers: *See:* **calibration marks.**

calibration marks: Indications superimposed on a display to provide a numerical scale of the parameters displayed.

cancellation ratio: **(A)** In moving-target indication (MTI), the ratio of canceler voltage amplification for fixed-target echoes received with a fixed antenna to the gain for a single pulse passing through the unprocessed channel of the canceler. This measure of MTI performance, in which high performance is represented by a low numerical value, has been largely replaced by the MTI improvement factor. **(B)** In interference-reduction techniques other than MTI: The cancellation ratio is the ratio of interference output power in the absence of the technique to that when the technique is applied, when the system gains for the two cases are adjusted to provide equal noise outputs. High performance is indicated by a high numerical value, generally expressed in decibels to avoid ambiguity between power and voltage ratios.

C-band: A radar-frequency band between 4 GHz and 8 GHz, usually in the International Telecommunications Union (~~ITU~~) allocated band 5.250 GHz to 5.925 GHz. ^{12 9}

NOTE—See IEEE [Std 521™-2019 \[B6\]](#) ~~Std 521-2002 [B5]~~.

carrier-controlled approach (CCA) system: An aircraft carrier radar system providing information [that](#) ~~which~~ facilitates direction of aircraft via radio communication.

chaff: Strips of lightweight metal or metalized material that are dispensed in large numbers (bundles) so as to simulate a true target, or, more [commonly](#) ~~usually~~, to create a large clutter signal that masks the detection of wanted targets. Note the following:

- Each bundle may contain thousands of individual reflectors whose lengths are related to the wavelength of the radar.
- Chaff for use at HF and VHF frequencies is sometimes called *rope*.

^{12 9}IEC publications are available from the International Electrotechnical Commission (<http://www.iec.ch>) and the American National Standards Institute (<https://www.ansi.org/> ~~<http://www.ansi.org/>~~). ISO publications are available from the International Organization for Standardization (<https://www.iso.org/> ~~<http://www.iso.org/>~~) and the American National Standards Institute (<https://www.ansi.org/> ~~<http://www.ansi.org/>~~).

— In WWII, chaff was called *window* in Great Britain and *Dueppel* in Germany.

chirp: A waveform used in ~~form-of~~ pulse compression that utilizes ~~uses~~ frequency modulation (usually linear) ~~during the pulse~~.

circulator: Device that can be used to provide isolation between transmitter and receiver. It is a passive, non- reciprocal three- or four-port device that only allows a microwave or radio-frequency signal to exit through the port directly after the one it entered.

clutter: Unwanted echoes, typically from the ground, sea, rain or other precipitation, chaff, birds, insects, meteors, and aurora. ~~Syn: background return.~~

clutter attenuation (CA): In moving-target indication (MTI) or Doppler radar, the ratio of the clutter power at the input to the clutter processor (~~but~~ after beamforming), to the clutter power at the output. In MTI, a single value of CA will be obtained, while in Doppler radar the value will generally vary over the different Doppler filters. *See also:* **MTI improvement factor**.

clutter detectability factor: The predetection signal-to-clutter ratio that provides the stated probability of detection for a given false-alarm probability in an automatic detection circuit. In moving-target indication (MTI) systems, it is the ratio after cancellation or Doppler filtering.

clutter fence: A barrier surrounding a ground-based radar to serve as an artificial horizon and suppress ground clutter.

clutter filter: A filter or group of filters (filter bank) included in a radar for the purpose of rejecting clutter returns and passing target returns at Doppler frequencies different from the Doppler frequencies of clutter. Moving-target indication (MTI) and pulsed-Doppler processors are examples.

clutter improvement factor: *See:* **MTI improvement factor**.

clutter map: Computer-stored values of radar-measured clutter for each range-azimuth or range-azimuth-elevation resolution cell or local region, used to set thresholds for each cell in a constant-false-alarm rate processor.

clutter reflectivity: The backscatter coefficient of clutter. *See also:* **backscatter coefficient**.

clutter residue: The uncanceled clutter power remaining at the output of a moving-target indication (MTI) or Doppler signal processor. ~~*See also:* canceled video.~~

clutter visibility factor: The predetection signal-to-clutter ratio that provides [a](#) stated probability of detection for a given false-alarm probability on a display. In moving-target indication (MTI) systems, it is the ratio after cancellation or Doppler filtering.

coast: A radar memory feature that causes the range or angle tracking systems to continue to move in the same direction and at the same rate that an original target was moving. It is invoked manually or automatically when the tracked target approaches a stronger echo (target or clutter) to prevent capture of the track by that echo or to maintain track over brief periods of signal loss.

coded pulse: A *pulse compression* waveform in which a long pulse is divided into many subpulses, with the phase of each subpulse assuming a discrete value (often 0 or π radians) chosen in a deterministic manner (as in Barker codes, which result in all time sidelobes being equal) or chosen in a pseudorandom manner (such as with linear recursive or maximal-length sequences). [It is noted that “coded pulses” typically refer to phase codes, yet frequency codings may also exist. Hence, pulse compression can be either phase or frequency coded.](#) See *also*: **Barker code**.

cognitive radar: A radar system that in some sense displays intelligence, adapting its operation and its processing in response to a changing environment and target scene. In comparison to adaptive radar, cognitive radar *learns to adapt* operating parameters as well as processing parameters [via a feedback and control process](#) and may do so over [multiple time scales and](#) extended time periods.

coherent integration: Integration of radio frequency (RF), intermediate frequency (IF), or bipolar envelope signals over an interval in which phase or polarity is preserved. See *also*: **integration (of radar signals)**.

coherent moving-target indication (MTI): The usual form of MTI in which a moving target is separated from large clutter echoes as a result of a pulse-to-pulse change in echo phase relative to the phase of a coherent reference oscillator. See: **moving-target indication**.

[coherent processing interval \(CPI\): time interval, during which the signal is processed coherently, e.g., filtered or correlated. See: coherent integration.](#)

coherent signal processing: Integration, filtering, or detection of an echo signal using the amplitude of the received signal and its phase referred to that of a reference oscillator or to the transmitted signal.

coherent oscillator (coho): Designating an oscillator used in a coherent radar to provide a reference phase by which changes in the phase of successively received pulses may be recognized. In practice, a coho usually operates at the receiver intermediate frequency.

collapsing loss: The increase in required input signal-to-noise ratio to maintain given probability of detection for a given false-alarm probability when resolution cells or samples containing only noise are integrated along with those containing signal and noise. This type of loss occurs, for example, when radar returns containing range, azimuth, and elevation information are constrained to a two-dimensional (2-D) display.

collapsing ratio: Indicated as the following ratio:

$$(m + n) / n \quad (3)$$

where

m is the number of noise-only samples

n is the number of signal-plus-noise samples

complex target: A target composed of more than one scatterer within a single radar resolution cell. A target may be both complex and distributed. *See also:* **distributed target**.

conformal array: An array antenna that is shaped to fit the surface of its host platform, such as an aircraft or [vehicle surface missile](#).

conical scanning: A form of angular tracking in which the antenna beam is offset from the tracking axis of the antenna. Rotation of the beam about the axis generates a cone whose vertex angle is of the order of the beamwidth. Such scanning may be either rotating or nutating, according to whether the direction of polarization rotates or remains unchanged. The variation of signal amplitude as the beam scans provides information on the amount and direction of displacement of the target from the axis of rotation.

conical-scan-on-receive-only (COSRO): A method in which only the receiving beam is conically scanned for angle tracking.

conopulse: A tracking radar that uses two simultaneous squinted beams that are rotated around the antenna boresight to produce, on a time-shared basis, monopulse angle-error signals in two orthogonal coordinates (such as azimuth and elevation). Note the following:

- Only two receivers are required rather than three as in the usual monopulse tracker.
- Also called *konopulse* and *scan with compensation*.

constant-false-alarm rate (CFAR) receiver: A radar receiver that maintains the output false-alarm rate constant ~~despite~~ ~~in spite of~~ the varying nature of the receiver noise level, echoes from the clutter environment, or from electronic [attack \(EA\)](#) ~~countermeasures (ECM)~~. CFAR is usually achieved by establishing a threshold level which varies according to the local noise and/or clutter environment measured in the near vicinity of the target echo.

continuous wave (CW) Doppler radar: A radar that transmits a CW signal and discriminates desired targets from other targets or clutter on the basis of the Doppler shift due to radial motion. *See ~~also~~: CW radar, Doppler radar.*

continuous wave (CW) radar: A radar that transmits a CW signal. *See ~~also~~: continuous wave Doppler radar.*

cooperative Radar Coexistence: A form of spectrum sharing between radar and communications systems where two or more systems exchange information, a priori or in real time, to mitigate interference. Cooperative coexisting services may be separate systems, requiring synchronization and coordination, or may be integrated into a unified platform where full synchronization is readily assumed. *See: radar coexistence, non-cooperative radar coexistence.*

corner reflector: Two (dihedral) or three (trihedral) orthogonal conducting surfaces, designed to return an incident electromagnetic wave toward its source. It is often used to provide a conspicuous radar target as a safety measure (for [example](#), a small sailboat), or to enhance the detectability of a radar target on which it is mounted or to calibrate a radar.

corporate feed: A feed structure for a phased array that has a signal path that divides repeatedly and provides equal path lengths from the source to each array element.

cosecant-squared pattern: A vertical-plane antenna pattern in which the transmitting and receiving power gains vary as the square of the cosecant of the elevation angle. The unique property of this pattern is that it results in the received echo signal being independent of range if the target is the following:

- a) Of constant radar cross section
- b) Moves at constant altitude
- c) The Earth's surface can be considered flat

See ~~also~~: **modified cosecant-squared antenna pattern.**

Costas code: A frequency-hopping pulse compression waveform in which a long pulse is divided into n subpulses with the frequency of each subpulse chosen from n contiguous frequencies in a manner first suggested by John P. Costas.

NOTE—See Costas [B2].

crabbing: Beam pattern distortion that is created when a platform is pointed in one direction while moving in a different direction when pointing a radar beam in a specific direction, particularly in synthetic aperture radar applications.

cross-ambiguity function: A function used to compare two different signals with respect to the range delay (τ) and Doppler frequency (f_d), used for example in passive radar to compare the echo signal with the reference signal transmitted by the illuminator of opportunity. The function is defined as the integral as follows:

$$\psi(\tau, f_d) = \int_{-\infty}^{\infty} x(t) y^*(t + \tau) \exp(j2\pi f_d t) dt \quad (4)$$

(New)

where

$x(t)$ is one of the two compared signals (e.g., the echo signal in passive radar)

$y(t)$ is one of the two compared signals (e.g., the reference signal passive radar)

$y^*(t)$ is the complex conjugate of $y(t)$

See: **ambiguity function.**

crosseye jamming jammer: A technique in which a jamming signal is radiated by two elements (or subarrays) fed in antiphase, giving a null on boresight and lobes of opposite phase either side of the null, to confuse a tracking radar.

cross polarization electronic attack (EA): An EA technique that transmits with a polarization orthogonal to the principal polarization of the victim radar. Since cross polarized antenna patterns are often much different from the normal, co-polarized patterns, tracking might be disrupted. *See also:* **electronic countermeasures.**

cross section: Often used as a shortened form of radar cross section (RCS). To be avoided when there is a possibility of confusion with geometric cross section.

crossover loss: For a tracker that uses an offset beam, such as a conical scan tracker, the reduction in signal-to-noise ratio for a target on the tracking axis relative to that for a target on the peak two-way antenna gain of the beam. The crossover loss factor is the ratio of the signal-to-noise ratio for a target on the peak two-way antenna gain to that for a target on the tracking axis. *See also:* **conical scanning.**

cumulative detection probability: The probability that a target is detected on at least one of n successive scans or detection opportunities of a surveillance radar.

data: Reinterpretable representation of information in a formalized manner suitable for communication, interpretation, or processing (adapted from ISO/IEC 2382-1). ^{13 10}

datum: A reference from which measurements are made. In surveying and geodesy, a datum is a reference point on the Earth's surface against which position measurements are made, and an associated model of the shape of the Earth for computing positions. Horizontal datums are used for describing a point on the Earth's surface, in latitude and longitude or another coordinate system. Vertical datums are used to measure elevations or underwater depths.

decoy: A device (physical or electronic) deployed such that it is detected rather than or in addition to the intended target, the intent being to prevent identification of the true target.

defensive aids suite (DAS): A suite of techniques used to detect incoming threats and deploy countermeasures (electronic and physical), and/or take evasive maneuvers.

¹³ ¹⁰ISO publications are available from the International Organization for Standardization (<https://www.iso.org/>) and the American National Standards Institute (<https://www.ansi.org/> <http://www.ansi.org/>).

defruiter: Equipment that deletes random asynchronous unintentional returns in a beacon system (commonly used in secondary surveillance radars). *See:* **fruit**.

depression angle: The vertical angle from the platform horizontal plane to the slant range direction, usually measured at the aperture reference point (ARP) (approximately the complement of the look-down angle).

depth of focus: In synthetic-aperture radar (SAR), the range interval over which the cross-range resolution is maintained without introducing or changing the focusing correction in signal processing.

designation: Selection of a particular target and transmission of its approximate coordinates from some external source to a radar—usually to initiate tracking.

detection: The process of determining the presence of a target.

detection probability: The probability that a signal, when actually present at the input to the receiver, will be correctly declared a target signal based on observation of the receiver output. *See also:* **false-alarm probability**.

detection range: The range at which a target is detected or for which the predicted detection probability equals some predefined value.

Dicke fix: An electronic protection (EP) technique designed to counter impulsive jamming and some types of swept-frequency jamming. The usual configuration is a broadband intermediate-frequency (IF) amplifier followed by a limiter and then an IF amplifier of optimum bandwidth for the radar signal.

difference channel (monopulse radar): A receiving channel in which the response, as a function of a given radar coordinate, approximates the first derivative of the response of the main (sum) channel, to indicate the displacement of the target from the center of the main channel. The term was originally applied to monopulse radar, in which the difference between two offset beams or antenna phase centers was used to generate an error signal for tracking. In more modern radars the difference channel in angle can be generated by a feed network producing an aperture illumination function with odd symmetry. Similar channels in range and Doppler coordinates can be generated by suitable gates and filters.