Appendix D
GLOSSARY OF TERMS

ABSORPTION
Absorption is a property of rain. The absorption is handled as a form of attenuation of the radar signal. The amount of absorption is determined by the size of the raindrops and the severity of the storm. A second form of absorption is caused by the atmosphere itself. The second form of absorption is dependent on the frequency of the transmitted signal and on the altitude of the ownship.

AIR TO GROUND RANGING (AGR)
Radar signal processing element which determines range to the ground along the antenna boresite.

ALTITUDE
Height or z-component of an aircraft's position; usually measured with respect to Mean Sea Level (MSL).

ATMOSPHERIC ATTENUATION
The diminution of a signal strength caused by the absorption of the energy by molecules in the air.

ATMOSPHERIC REFRACTION
The deviation (from a direct line) of the radar signal or return due to atmospheric effects, i.e. moisture, ionization, etc.

ATTENUATION
Attenuation, as a variable, is a scaling factor for radar return signal strength. Attenuation is calculated based on ownship altitude, ownship distance to target, atmosphere, and rain conditions. Once calculated for a given situation, the variable can be applied to all radar return signals returning under similar conditions.

AUTOMATIC GAIN CONTROL (AGC)
Automatic adjustment of receiver gain based on received signal strength in an attempt to moderate overall received signal strength. A mechanism used to keep the gain of a radar calibrated such that energies returned from various environmental features are weighted correctly with respect to one another.

AZIMUTH
The horizontal pointing angle of an antenna (in the x-y plane) relative to boresight heading of the aircraft.

AZIMUTH EXTENT
Azimuth extent is a variable defining the leftmost or rightmost edge of the viewing area in expand mode. The two azimuth extent variables (left and right) may be expressed in degrees from center.

AZIMUTH RESOLUTION
The limit of the radar's ability to distinguish two targets in azimuth. This is typically a function of antenna beam pattern & radar signal processing.

B SCAN
A display format which shows range information along vertical lines with each vertical line representing a different azimuth. For example, for a ±20 degree azimuth scan with a range of 30 miles, the left vertical edge of the screen represents 20 degrees left of the scan center, the right vertical edge of the screen represents 20 degrees right of the scan center, the lower edge of the screen represents the eyepoint (zero range) and the top of the screen represents a range of 30 miles.

BACKSCATTER
Backscatter is a reflection from any object in the path of the radar.

BEAMWIDTH
Beamwidth generally refers to the angular width of the main lobe of the real-beam radar expressed in degrees. The beamwidth is affected by the frequency transmitted and by the geometry (especially the width) of the radar antenna. An antenna may have different beamwidths in the vertical and horizontal directions.

BORESITE/BORESIGHT
The forward direction of the aircraft along the centerline of the fusillage. (Equivalent to azimuth/elevation of 0 degrees.)

DATABASE UTILITIES
Software tools used to reformat terrain and feature databases of various formats into a runtime format capable of being read by the Radar Toolkit™

DISPLAY HORIZONTAL / VERTICAL RESOLUTION
The number of displayable pixels on a display along the horizontal/vertical axis.

DOPPLER
Frequency shift in radar returns due to relative motion of radar and target.

DOPPLER BEAM SHARPENING (DBS)
A coherent ground map mode which provides higher azimuth resolution by processing the radar return signal phase to exploit the doppler dependency on azimuth angle. The DBS mode is defined as having constant angular resolution, as opposed to the constant cross-range resolution of SAR. The DBS mode provides a large area map and is useful for defining land/water boundaries, landmark identification, etc. The display format is Plan Position Indicator (PPI) with large range and azimuth extent to provide wide coverage of the aircraft forward sector similar to Real Beam Ground Map (RBGM). The DBS mode forms an image while scanning the antenna toward the velocity vector.

DOPPLER NOTCH
Region along velocity vector where integration time becomes excessive.

DWELL
Time that an environmental entity is illuminated by a radar.

DWELL LEVEL
Refers to processing done during a single dwell of the radar antenna. A dwell is the smallest azimuthal arc which a certain radar system (antenna, receiver, and signal processor) can discern information.

E SCAN (TERRAIN FOLLOWING SCAN)
A display format which shows the terrain elevations in front of the aircraft.

EARTH CURVATURE COMPENSATOR
The earth curvature compensator calculates the relationship (caused by the earth's curvature) between actual antenna tilt angle and effective antenna tilt angle based on the ownship's altitude and the distance to the target.

ELECTRONIC COUNTER COUNTERMEASURE (ECCM)
Electronic activity designed to reduce the effectiveness of an enemy's electronic countermeasures efforts.

ELECTRONIC COUNTERMEASURE (ECM)
Electronic activity designed to reduce the effectiveness of an enemy's electronic surveillance equipment.

ELEVATION RESOLUTION
The limit of the radar's ability to distinguish two targets in elevation. This is typically a function of antenna beam pattern.

EMITTER
A device which emits (transmits) certain electromagnetic energy into the environment, and which therefore can be sensed by a sensor.

EXPAND AREA MAP
Similar to a LAM, an expand area map represents a higher resolution area which is sampled to produce Doppler Beam Sharpened (DBS) images or Synthetic Aperture Radar (SAR) images.

EXPAND MODE
Modes which enhance a subregion through offset subsampling, video replication, or doppler processing.

FAR SHORE BRIGHTENING
The far shore of a lake shows up much brighter than the surrounding terrain because radar waves bounce off of water and add to the RF signal power illuminating the far shore.

FEATURE DECORRELATION
Feature decorrelation is an effect seen in Doppler radar images. It is caused by the motion of a target or by motion of objects on the ground (tanks, windblown trees, etc.). Feature decorrelation appears as an incorrect display location for a moving target or as speckles around windblown trees. Within the context of the Radar Toolkit decorrelation is simply an attribute that indicates the amount of decorrelation caused by an object.

FEATURE DECORRELATOR
SAR and DBS often use multiple images to reduce random noise effects. This means that if a feature such as a tree is moving (in the wind) it may blur, fade, or disappear.

FEATURE IDENTIFICATION CODE (FIC)
An attribute given to features in DMA DFAD data which describes the feature type, such as metal bridge, divided highway, or river subject to seastate; in the range [100–999].

FLIGHT MODELLER
The collection of algorithms that specify or simulate the aerodynamic behavior of a given aircraft.

FREQUENCY
The RF frequency of the transmitted radar beam or pulses. The transmitter frequency affects the directionality of the antenna, the curvature of the radar signal, and the level of atmospheric absorption. The standard microwave frequency bands are: S-Band (2-4 Ghz), C-Band (4-8 Ghz), X-Band (8-12.5 Ghz), Ku-Band (12.5-18 Ghz), and Ka-Band (26.5-40 Ghz).

FREQUENCY BAND
International Telecommunications Union (ITU) assigned portions of the electromagnetic spectrum various designators. The military has alternate designators for the regions commonly used in military applications.

FREQUENCY BIN
A single element of a radar receiver which is fed by one or more doppler filters tuned to collect desired return frequencies. In doppler radar modes (high PRF), the frequency bin collects data over a given frequency spectrum. The given interval size changes with frequency sub- band selections (such as Nose, Beam, or Tail aspect).

FILTER
Hardware or software used to identify and eliminate unwanted information and to identify and pass useful wanted information.

GAIN
Gain is the ratio of output power to input power for any component of the radar that changes the amplitude of a signal. The radar receiver produces a gain in the RF signal. The antenna also has a gain based on its ability to focus the RF signal on a target. The RF power levels and the gains of components in the radar system are usually expressed in decibels. Components of the radar system which attenuate the radar signal are said to have negative gain because their power gain expressed in decibels is a negative number.

GEOMETRIC DISTORTION
In certain display formats, perspective is not maintained and images can be warped.

GIMBAL
Assembly of rings, bearings, and encoders to provide free antenna motion along desired axis.

HEADING
The angle (usually North relative) which represents the direction an aircraft's nose is headed.

HEIGHT ABOVE TERRAIN
Vertical distance between the aircraft and the ground, typically provided by a radar altimeter (RALT). Most RALTs are valid only below a certain altitude (typically 1000 feet or less) and only within certain pitch/roll limits. E.g., if the aircraft is rolled 90 deg over flat terrain, the HAT is obviously not infinity.

HIGH RESOLUTION CORRIDOR / AREA
In a real-time visual or radar database, an area such as a bombing/strafing range or set of turnpoints which is enhanced to a greater degree than the surrounding terrain. Usually, more real-world feature data is added to make the area recognizable to the pilot.

HOST
Master computer driving necessary data for simulation.

I,Q VALUE
The in-phase and quadrature components of a signal. A radar receiver separates the incoming signal into these two components, sends them through a low-pass filter, and then into the signal processor, where they are recombined.

JAMMER
Electronic devices that transmit high-power signals modulated with noise or other disruptive variations in amplitude or frequency which are contrived to impair a radar's operation in various ways: saturate its receiver, obscure target echoes on its display, deny it information from a particular block of ranges, etc.

LAND / LANDMASS / TERRAIN
Land is that part of the earth that stands above mean sea level. Landmass includes land and sea. Terrain includes the physical features of a track of land, a geographical area.

LEADING EDGE BRIGHTENING
Leading edge brightening occurs in a radar display because the radar signal strikes the leading edge of objects at a very sharp angle of incidence relative to the surrounding terrain.

LINE OF SIGHT
An aim or observation taken with mechanical or optical aid to establish a direct path to an object, target, etc.

LOBE
A geometric area, relative to the source of an emitter (radar transmitter), in which there is radiated energy, and therefore return energy which is collected and analyzed to obtain information about the environment. Usually described in two perpendicular planes: the horizontal (azimuthal) beam gain pattern, and the vertical (elevational) beam gain pattern.

LOCAL AREA MAP
In a real-time sensor simulation, terrain and feature data must be 'paged' into memory and kept current based on the position of the ownship aircraft; this memory region is then sampled to provide a sensor system display. The virtual extent of this 'paged-in' data is the local area map (LAM).

MAIN LOBE
The primary and strongest lobe usually centered around the transmitting aerial antenna pointing angle.

MOTION COMPENSATION ERROR
Discrepancy between predicted and actual aircraft path and velocity that can cause Doppler ground map positional error and attenuation.

MOVING TARGET POSITION ERROR
When using doppler processing to enhance the resolution of a map, return from a moving target will have a frequency shift proportional to the targets radial velocity. The positional error (azimuth shift) is a vr / sin (q): vr is radial velocity, q is squint angle.

OCCULTING
Surface features and targets that are hidden behind ridges should not show up on the radar display. Every target and every terrain grid that is hidden from the radar's line-of-sight must be detected and marked. In addition, hidden target information must be passed from the radar simulator to the host in order for the host to control the threats and targets realistically.

ON BOARD COMPUTER
Computer system located on an aircraft that generally interfaces with a radar system to provide such functions as track file management, weapons fire control, etc.

OWNSHIP
Platform (such as an aircraft) with which a simulated radar is associated.

PAC DETECTOR
Logic used to determine when reliable information can no longer be derived from radar return energy because too much signal attentuation is occuring to allow it.

PAGER
A software mechanism used to convey information from one source to another upon demand. In the context of the radar simulation, a pager is a software process used to convey information such as terrain or weather descriptions between secondary storage and RAM so as to keep such information up to date in immediate proximity to the current point of interest.

PATCH
A high-resolution image of a small area, generated in SAR mode (Synthetic Aperture Radar).

PATH ATTENUATION CAUTION (PAC)
PAC is a discrete signal indicating that the signal returning from a target is insufficiently bright to extract reliable processed information (range, altitude, velocity ..etc.) about the target. PAC is calculated by the radar system and is used to drive a pilot warning.

PITCH
The angle in the vertical plane which represents how much an aircraft's nose is pointed up or down relative to local horizontal. Rotation about the lateral axis.

PLAN POSITION INDICATOR (PPI)
A display format which shows the radar image as a 'God's eye' view in the familiar 'pie-shape' wedge.

POLARIZATION
Radar RF signals have four possible polarizations: horizontal, vertical, left circularly polarized, and right circularly polarized. A radar antenna transmitting with one polarization will be most receptive to signals returning from a target with the same polarization. Horizontal and vertical polarization is referenced (in direction of polarization) to the aircraft. Flying at an angle does not change the polarization of the radar signal from the point of view of the aircraft.

POST DETECTION INTEGRATOR
Post-Detection Integration is a semi-effective method or reducing the amount of noise in a radar image by averaging radar returns over a number of detections. The averaging is applied to the signal after all other processing has been applied to it. The simulation of Post-Detection Integration could take many forms. Actual radar system use electronic integration, digitally processed integration, and even slowly decaying phosphors in the radar display itself.

POST PROCESSOR
The post-processor of an actual radar system takes simple (partly processed) data and performs calculations necessary for a given aircraft's mission. The post-processor produced in software must be designed to simulate different tasks for different radar systems. Traditionally post- processor on actual aircraft have been configurable on the ground, but not during flight.

POWER
Power refers to the instantaneous peak power of the radar transmitter. The average power output of a radar transmitter (the amount of power illuminating a target) is less than the transmitter power because the transmitted signal is pulsed. The exact amount of illuminating energy (power times time) is affected by the PRF (Pulse Repetition Frequency) and the Duty Cycle of the transmitted pulses.

PULSE LENGTH EFFECT
Variation in range resolution and minimum detectable range attributable to changes in length of radar pulse.

PULSE REPETITION FREQUENCY (PRF)
The rate at which radar pulses are sent out from the transmitter (HZ); determines the pulse repetition interval or intrapulse period.

PULSE REPETITION INTERVAL (PRI)
Equivalent to the inverse of the pulse repetition frequency (PRF).

RADAR
Radio Detecting and Ranging. An active microwave imaging system.

RADAR ANTENNA TYPE
(Phased array, dish, slotted array, steerable phased array, electronically steered array.) A value used to specify one of a set of enumerated values identifying possible radar antenna types.

RADAR CONTROL
A set of radar inputs generally available to a radar operator which affect the operation of the radar. These can include radar mode, range, power, display, and signal processor controls.

RADAR MODE
The radar mode is a single discrete attribute representing a predetermined configuration of control, signal processing, antenna movements, and display method. The radar mode may be changed at any time during a simulation, and must produce a modification in the simulation's performance within the time required by the actual radar system being simulated to make a similar mode change. The actual modes will be configurable.

RADAR RETURN LEVEL
This is the energy detected by the radar. It includes evergy reradiated by the environment and direct path energy from other active systems such as radars, radios, jammers, and electromagnetic noise in the atmosphere.

RADAR TRANSMISSION TYPE
(Continuous beam radar, coherent pulse, noncoherent pulse.) A value used to specify one of a set of enumerated values identifying possible radar transmission types.

RANGE
Range is the distance from the radar antenna to any given object of the ground producing a reflection. Range is calculated based on the period of time required for the transmitted signal to return as a reflection from an object.

RANGE ATTENUATION
Range attenuation is the diminution of a signal strength caused by range. Signal strength falls off with the square of the range.

RANGE BIN
A single element of a radar receiver which collects return energy for a portion of the entire radar trace. In pulse radar modes (low PRF), the range bin collects data over a given time interval. The given interval size changes with range scale.

RANGE EXTENT
Range extent is a variable defining the maximum (or minimum) distance edge of the viewing area in expand mode. The two range extent variables (min-extent and max-extent) may be expressed as a fraction of the overall range, which is measured to the center of the viewing area.

RANGE FORESHORTENING / FEATURE LAYOVER
Features whose vertical extent exceeds the radar's range resolution become distorted in range, appearing to layover or layback depending on the viewport location.

RANGE RESOLUTION
The limit of the radar's ability to distinguish two targets in range. This is typically a function of pulse width and pulse compression processing.

RADAR RETURN
RF energy reflected back to the radar by the environment.

RANGE SCALE
The range scale is a single discrete attribute indicating which of several predetermined sets of limits will be imposed on the size of the area or regard for the radar. It may also be used to select one of several pre-determined maximum ranges for the real-beam radar.

RANGE TRACE
When a video beam sweep is initiated on a CRT display by a radar pulse, the distance along the sweep correlates to the time required for the radar signal to travel out and the echo to be reflected back. Thus

RECEIVER GAIN
Receiver gain is a measure of the effective area of the antenna. It is typically expressed as a ratio to a nominal omnidirectional antenna.

RECEIVER NOISE
Inadvertent noise added to radar signal upon its return to the antenna.

REFLECTIVITY
Reflectivity is one of the attributes associated with each polygon in a polygonal terrain file and with each sector of a gridded terrain map. Reflectivity is a floating point variable which indicates an object's ability to reflect a radar signal. Reflectivity alone does not determine the power of the radar reflection. The amount of signal reflected also depends on the angle of incidence and the surface area of the object.

REFLECTOR
An object in the environment which typically is highly reflective of electromagnetic waves, due to its geometry and surface material type. It may even have a "signature" (identifying) return. Several classes exist, including corner reflectors (a structure with one or more 90-degree angles).

RF ENERGY
Radio frequency energy is that energy found in the radio portion of the frequency spectrum.

ROLL
The angle in the vertical plane which represents how much an aircraft's wings are tilted (or rolled) relative to local horizontal. Rotation about the longitudinal axis.

SCAN
Antenna scan pattern, typically referring to the range of the scan pattern in azimuth. May also be used in conjunction with scan patterns consisting of multiple elevations, as in 2-bar scan or 4-bar scan, etc.

SCINTILLATION
Generic term for rapid variations in apparent position, brightness, or color of a distant luminous object viewed through the atmosphere. A flash of light produced in a phosphor by an ionizing event. On a radar display, a rapid apparent displacement of the target from its mean position.

SEA STATE
The condition of the seas (with respect to wave activity), usually specified as one value of an enumerated set.

SEASONAL EFFECTOR
Agent that applies appropriate influence on environmental entities to indicate effect of the seasons.

SECOND TIME AROUND ECHO
Return from a radar pulse from a distant object which arrives back at the radar antenna after another pulse has been sent. Can make bright, distant targets appear closer and smaller.

SECTOR
Portion of full scan.

SENSITIVITY TIME CONTROL (STC)
A means of adjusting receiver gain over an intrapulse period so that the naturally strong echoes from close ranges are greatly attenuated, thus preventing saturation, and allowing the weak echoes from far ranges to be seen. Used in low PRF modes to reduce amplitude of sidelobe clutter beneath sensitivity threshold. A typical attenuation (inverse gain) curve is 1/R4.

SHADOW
Image made by an obscured space on a surface that cuts across it usually representing in silhouette the form of the interposed body.

SIDE LOBE
Secondary and lesser lobes which differ in angle from the main lobe, yet still provide return data (usually unwanted return which much be filtered or reduced).

SIGNAL PROCESSOR
Digital or analog radar subsystem that analyses and classifies radar return energy by range, filters out clutter, senses doppler shifts, resolves range and/or doppler ambiguities, performs target detection, etc.

SNOWPLOW MODE
The radar scans at a fixed or commanded azimuth with respect to platform (airframe) coordinates, "plowing" along as platform moves.

SPECKLE
Speckle is form of display image deterioration caused by random noise. Speckle appears as randomly positioned (and randomly occurring) dot-sized spots on the radar display. The amount of speckle is affected by range, signal strength, atmospheric conditions, weather, etc.

SPOKE EFFECT
A radial incongruity or spike in PPI-scan radar images caused by interference from an emitter or atmospheric disturbances.

STABILIZE MODE
1.The radar scans such that the radar look vector "tracks" a designated point in space (or on the ground).

2. Antenna gimbals compensate for platform orientation (in pitch and roll) such that information is displayed in inertial coordinates.

STEALTH
1. To lower the RCS of an object to minimize detection by radar.

2. To operate a radar in such a manner as to minimize detection (as in LPI – Low Probability of Intercept).

SURFACE MATERIAL CODE (SMC)
An attribute given to features in DMA DFAD data which describes the surface material and thus the relative reflectivity of that feature; for example, metal, water, or soil; in the range [1–14].

SYNTHETIC APERTURE RADAR (SAR)
A coherent ground map mode which provides higher azimuth resolution by processing the radar return signal phase to exploit the doppler dependency on azimuth angle. The SAR mode is defined as having constant cross-range resolution, as opposed to the constant angular resolution of DBS. The SAR mode provides a small patch map and is useful for target recognition, aimpoint selection, etc. The display format is offset sector PPI. The SAR mode forms an image while the antenna is stabilized to point at the patch. The real beam antenna beamwidth limits the azimuth coverage and thus a mosaic of strips may be used to construct the composite image.

TARGET
Any specific unit which returns a unique radar return whose properties are capable of being analyzed for classification and tracking.

TARGET ASPECT
Target aspect refers to the relative geometry of the target and the radar platform. It directly affects the total cross-section presented to the radar wavefront.

TERRAIN
Terrain encompasses the physical features of a track of land, a geographical area.

TILT
The elevation of the radar look vector with respect to the horizon (if stabilized) or the platform (if not stabilized).

USER INTERFACE
A set of menus available to the user of the Radar Toolkit which provide input controls (including radar controls, ownship/target positioning, environmental parameters) and allow the Radar Toolkit to be run in a host emulation mode.

VERTICAL SCAN
Vertical scan is a scanning mode used for terrain following radar systems. In this mode the real-beam radar antenna is scanned up and down to produce accurate range and altitude measures in the region immediately in front of the aircraft.

VISUAL CUE
Visual indication to a radar operator of certain radar or environmental conditions.

WAVE
A radar wave has a frequency, a phase shift, an amplitude, a polarization, a pulse repetition frequency, etc. A radar wave interacts with the environment in that it is attenuated, reflected, scattered, and it provides information for the radar receiver.

WEATHER SCENARIO
A weather scenario is a description of a collection of weather patterns over time.

WEATHER SPECKLE
Random variation in radar returns from and through weather due to the complex reflective/refractive nature of the atmosphere inside weather cells.

WIND SHEAR
A condition which exists along a boundary between two air masses of opposing wind directions. Wind shear can be detected by doppler radar.

WAVE GUIDE
A metallic microwave conductor, typically rectangular in shape, used to carry microwave signals into and out of microwave antennas.

X BAND
Radar is transmitted in a wide range of frequencies. The frequency spectrum has for many years been divided into several standard bands. A radar system can operate within any one of these bands, but systems seldom are designed to span bands. X-Band is thus one of the discrete values that can be assigned to a which-band flag. Radar systems are currently designed to work within the following bands: S-Band (2-4 Ghz), C-Band (4-8 Ghz), X-Band (8-12.5 Ghz), Ku-Band (12.5-18 Ghz), and Ka-Band (26.5-40 Ghz).

YAW
The angle in the horizontal plane which represents how much an aircraft's nose is offset from its actual heading. Rotation about the vertical axis.