

PRINCIPLES OF GNSS, INERTIAL, AND MULTISENSOR INTEGRATED NAVIGATION SYSTEMS

BY PAUL D. GROVES

List of acronyms and abbreviations

ABAS	Aircraft-Based Augmentation System	CL	Civil Long
ABS	Anti-lock Braking System	CM	Civil Moderate
ACU	Antenna Control Unit	COD	Cross Over Dot product
ADC	Analog to Digital Converter	CRPA	Controlled-Reception-Pattern Antenna
ADR	Accumulated Delta Range	CS	Commercial Service
AES	Aerospace and Electronic Systems	CTP	Conventional Terrestrial Pole
AFLT	Advanced Forward-Looking Trilateration	CTRS	Conventional Terrestrial Reference System
AGARD	Advisory Group for Aerospace Research and Development	CVL	Correlation Velocity Log
AGC	Automatic Gain Control	CVN	Continuous Visual Navigation
AGNSS	Assisted GNSS	CZM	Conventional Zero Meridian
AHRS	Attitude and Heading Reference System	DCO	Digitally-Controlled Oscillator
AIAA	American Institute of Aeronautics and Astronautics	DDC	Decision-Directed Cross-product
AltBOC	Alternate Binary Offset Carrier	DDM	Difference in Depth of Modulation
AM	Amplitude Modulation	DDQ	Decision-Directed Quadrature
AM	Annual Meeting	DEM	Digital Elevation Model
ANFIS	Adaptive Neuro-Fuzzy Inference System	DGNSS	Differential GNSS
AOA	Angle Of Arrival	DGPS	Differential GPS
AP	Access Point	DLL	Delay Lock Loop
AR	Auto-Regressive	DME	Distance Measuring Equipment
AS	Anti Spoofing	DOD	Department Of Defense
ASF	Additional Secondary Factor	DOP	Dilution of Precision
ATAN	ArcTANgent	DPP	Dot-Product Power
ATAN2	ArcTANgent (four quadrant)	DR	Dead Reckoning
ATC	Adaptive Tightly-Coupled	DTED	Digital Terrain Elevation Data
ATF	Adaptive Transversal Filter	DTM	Digital Terrain Model
AtoN	Aid to Navigation	DVL	Doppler Velocity Log
Autonav	Automatic navigation	ECEF	Earth-Centered Earth-Fixed
AUV	Autonomous Underwater Vehicle	ECI	Earth-Centered Inertial
baro	barometric altimeter	EGI	Embedded GNSS (or GPS) in INS
BOC	Binary Offset Code	EGM 96	Earth Gravity Model 1996
BPF	BandPass Filter	EGNSS	Enhanced GNSS
BPSK	Bi-Phase Shift Key	EGNOS	European Geostationary Navigation Overlay System
C/A	Coarse/Acquisition	EKF	Extended Kalman Filter
CASM	Coherent Adaptive Sub-carrier Modulation	ELE	Early-minus-Late Envelope
CCD	Charge-Coupled Device	ELoran	Enhanced Long range navigation
CDMA	Code-Division Multiple Access	ELP	Early-minus-Late Power
CE	Common Era	ENC	European Navigation Conference
CIRS	Conventional Inertial Reference System	EOTD	Enhanced-Observed Time Difference
		ESA	European Space Agency
		EU	European Union

FDIS	Frequency-Domain Interference Suppressor	IAE	Innovation-based Adaptive Estimation
FDMA	Frequency-Division Multiple Access	IAIN	International Association of Institutes of Navigation
FDE	Fault Detection and Exclusion	IBLS	Integrity Beacon Landing System
FDI	Fault Detection and Isolation	ICD	Interface Control Document
FDR	Fault Detection and Recovery	ID	IDentification
FEC	Forward Error Correction	IEEE	Institute of Electrical and Electronic Engineers
FFR	Federated Fusion-Reset	IEE	Institute of Electrical Engineers
FFT	Fast Fourier Transform	IERS	International Earth Rotation and reference systems Service
FH	Frequency Hopping	IF	Intermediate Frequency
FLL	Frequency Lock Loop	IFOG	Interferometric Fiber-Optic Gyro
FM	Frequency Modulation	IGMAP	Iterative Gaussian Mixture Approximation of the Posterior
FMCW	Frequency-Modulated Continuous-Wave	IGRF	International Geomagnetic Reference Field
FNR	Federated No-Reset	IGS	International GNSS Service
FOC	Full Operational Capability	ILS	Instrument Landing System
FOG	Fiber-Optic Gyro	IMU	Inertial Measurement Unit
FTA	Fine Time Aiding	INS	Inertial Navigation System
FWHM	Full Width at Half Maximum	INU	Inertial Navigation Unit
FZR	Federated Zero-Reset	IOC	Initial Operational Capability
GAGAN	GPS/GLONASS And Geo-Augmented Navigation	IODA	Issue Of Data Almanac
GBAS	Ground-Based Augmentation System	IODC	Issue Of Data Clock
GBCC	Ground-Based Control Complex	IODE	Issue Of Data Ephemeris
GCS	Ground Control Segment	IODNav	Issue Of Data Navigation
GDOP	Geometric Dilution of Precision	ION	Institute Of Navigation
GLONASS	GLObal NAVigation Satellite System <i>or</i> GLObal'naya NAVigatsionnaya Sputnikovaya Sistema	IOV	In-Orbit Validation
GMS	Ground Mission Segment	IPF	Integrity Processing Function
GNSS	Global Navigation Satellite Systems	IQP	In-phase Quadrature Product
GPS	Global Positioning System	IR	Impulse Radio
GRAS	Ground-based Regional Augmentation System	IRM	IERS Reference Meridian
GRI	Group Repetition Interval	IRNSS	Indian Regional Navigation Satellite System
GSA	GNSS Supervisory Authority	IRP	IERS Reference Pole
GSM	Global Standard for Mobile communications	IS	Interface Standard
GSS	Galileo Sensor Stations	ITRF	International Terrestrial Reference Frame
GST	Galileo System Time	JION	Journal of the Institute of Navigation
gyro	gyroscope	JPO	Joint Program Office
HAL	Horizontal Alert Limit	JTIDS	Joint Tactical Information Distribution System
HARS	Heading and Attitude Reference System	KCPT	Kinematic Carrier Phase Tracking
HDOP	Horizontal Dilution of Precision	KF	Kalman Filter
HOW	HandOver Word	laser	light amplification by stimulated emission and radiation
HP	High Performance	LAAS	Local Area Augmentation System
HPL	Horizontal Protection Level	LADGNSS	Local Area Differential GNSS
HRG	Hemispherical Resonator Gyro		
HZA	High Zenith Antenna		

L-AII	Legacy Accuracy Improvement Initiative	OCS	Operational Control Segment
LAMBDA	Least-squares AMBiguity Decorrelation Adjustment	OCXO	Oven-Controlled crystal Oscillator
LBL	Long BaseLine	OS	Open Service
LDC	Loran Data Channel	PDAF	Probabilistic Data Association Filter
LHCP	Left-Handed Circular Polarization	PDF	Probability Density Function
LEX	L-band Experimental	PDOP	Position Dilution of Precision
LOP	Line Of Position	PDR	Pedestrian Dead Reckoning
Loran	Long-range navigation	PIGA	Pendulous Integrating Gyro Accelerometer
LSB	Least Significant Bit	P	Precise
L1/2/3/5	Link 1/2/3/5	PLANS	Position, Location And Navigation Symposium
L1C	Link 1 Civil	PLL	Phase Lock Loop
L2C	Link 2 Civil	PLRS	Position Location Reporting System
L5I	Link 5 In-phase	ppm	parts per million
L5Q	Link 5 Quadrature	PPP	Precise Point Positioning
M	Military	PPS	Precise Positioning Service
MBOC	Modified Binary Offset Carrier	PRN	Pseudo-Random Noise
MC	Multi-Carrier	Proc.	Proceedings of
MCMCMC	Metropolis-Coupled Monte-Carlo Markov Chain	PRS	Public Regulated Service
MCS	Master Control Station	PSD	Power Spectral Density
MEDLL	Multipath-Estimating Delay Lock Loop	PVT	Position, Velocity and Time
MEMS	Micro-Electro-Mechanical Systems	P(Y)	Precise (encrYpted precise)
MEO	Medium Earth Orbit	QC	Quadrature Channel
MET	Multipath Elimination Technology	QOI	Quadrature Over In-phase
MHKF	Multiple-Hypothesis Kalman Filter	QPSK	Quadrature-Phase Shift Key
MHT	Multiple-Hypothesis Tracking	QZSS	Quasi-Zenith Satellite System
MIDS	Multi-functional Information Distribution System	radalt	radar altimeter
MIT	Massachusetts Institute of Technology	RADGNSS	Regional Area Differential GNSS
MLA	Multipath-Limiting Antenna	RAIM	Receiver Autonomous Integrity Monitoring
MMAE	Multiple-Model Adaptive Estimation	RelNav	Relative Navigation
MOEMS	Micro-Optical-Electro-Mechanical Systems	RF	Radio Frequency
MOG	Micro-Optic Gyro	RFID	Radio-Frequency IDentification
MSAS	MTSat Satellite Augmentation System	RFOG	Resonant Fiber-Optic Gyro
MTSat	Multi-function Transport Satellite	RGNSS	Relative GNSS
NASA	National Aeronautical and Space Administration	RHCP	Right-Handed Circular Polarization
NATO	North Atlantic Treaty Organization	RIN	Royal Institute of Navigation
NAVSTAR	Navigation by Satellite Ranging and Timing	RLG	Ring Laser Gyro
NCO	Numerically-Controlled Oscillator	RMS	Root Mean Square
NDB	Non-Directional Beacon	RNP	Required Navigation Performance
NED	Nominal Emission Delay	ROV	Remotely-Operated Vehicle
NGA	National Geospatial-Intelligence Agency	RSS	Root Sum of Squares
NIMA	National Imagery and Mapping Agency	RSS	Received Signal Strength
NTM	National Technical Meeting	RTCM	Radio Technical Committee for Maritime services
		RTK	Real-Time Kinematic
		RTS	Rauch, Tung, and Striebel
		SA	Selective Availability

SAR	Synthetic Aperture Radar	USSR	Union of Soviet Socialist Republics
SAR	Search And Rescue	UTC	Ultra-Tightly-Coupled
SBAS	Space-Based Augmentation System	UTC	Universal Co-ordinated Time
SC	Special Committee	UWB	Ultra WideBand
SDR	Software Defined Receiver	VAL	Vertical Alert Limit
SF	Significant Figures	VBA	Vibrating-Beam Accelerometer
SI	Système International d'unités	VDOP	Vertical Dilution of Precision
SITAN	Sandia Inertial Terrain Aided Navigation	VHF	Very High Frequency
SMAC	Scene Matching by Area Correlation	VLBI	Very Long Baseline Interferometry
SNAS	Satellite Navigation Augmentation System	VOR	VHF Omnidirectional Radiorange
SNU	Standard Navigation Unit	VPL	Vertical Protection Level
SOL	Safety Of Life	WAAS	Wide Area Augmentation System
SPARTAN	StockPot Algorithm for Robust Terrain Aided Navigation	WADGNSS	Wide Area Differential GNSS
SPIE	Society of Photo-optical Instrumentation Engineers	W-CDMA	Wideband Code Division Multiple Access
SPS	Standard Positioning Service	WGS 84	World Geodetic System 1984
SV	Space Vehicle	WLAN	Wireless Local Area Network
TACAN	TACTical Air Navigation	WMM	World Magnetic Model
TAI	International Atomic Time	WSS	Wheel Speed Sensor
TAN	Terrain-Aided Navigation	XO	crystal Oscillator
TCAR	Three-Carrier Ambiguity Resolution	Y	encrYpted precise
TCM	Terrain Contour Matching	ZUPT	Zero velocity UPdaTe
TCN	Terrain-Contour Navigation	ZVU	Zero Velocity Update
TCXO	Temperature-Compensated crystal Oscillator	8PSK	8-Phase Shift Key
TD	Time Difference		
TDDM	Time-Division Data Multiplexing		
TDM	Time-Division Multiplex		
TDMA	Time-Division Multiple Access		
TDOA	Time Difference Of Arrival		
TDOP	Time Dilution of Precision		
TERCOM	TERrain COntour Matching		
TERPROM	TERrain PROfile Matching		
TOA	Time Of Arrival		
TOT	Time Of Transmission		
TRN	Terrain-Referenced Navigation		
TT&C	Telemetry, Tracking and Control		
UAV	Unmanned Air Vehicle		
UDA	UnDefined Acronym		
UDU	Upper Diagonal Upper		
UERE	User-Equivalent Range Error		
UHF	Ultra High Frequency		
UK	United Kingdom		
URA	User Range Accuracy		
US	United States		
USNO	US Naval Observatory		