# The Status of NAVIPEDIA

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Sochi, 8 November 2016

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# NAVIPEDIA: the GNSS wiki

esa navipedia — European Space Agency

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"The reference for Global Navigation Satellite Systems."

**Browse Articles by Category**

global navigation satellite systems: GALILEO, GPS, GLONASS, BEIDOU

satellite based augmentation systems: EGNOS, WAAS, MSAS, other SBAS

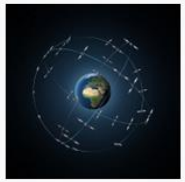
regional navigation satellite systems: IRNSS, QZSS, other regional systems

fundamentals, receivers and applications: GNSS fundamentals, GNSS receivers, GNSS applications

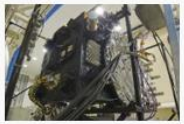
**News**
- EGNOS-based landings at Europe's largest mainland airport
- Former Galileo Director honoured with satnav leadership award
- Fantastic four: November's Galileos reach Europe's Spaceport
- Galileo's Ariane 5 arrives at Europe's Spaceport
- Salvaged Galileos to help satnav specialists find their way

Archive

**Highlights**



30-satellite Galileo constellation



Galileo emerging from TVAC

**Quick References**
- GALILEO Brochure (ESA)
- Current and Planned Global and Regional Navigation Systems (UNOOSA-ICG)
- Galileo IOV Factsheet
- Galileo FOC Factsheet
- ESA GNSS Data Processing Book

**www.navipedia.org**

# NAVIPEDIA: Mission

- The current GNSS international scenario is very dynamic (GPS modernisation, Glonass modernisation, Galileo, COMPASS, QZSS, IRNSS, new SBASs, …). It is then difficult to keep track of the latest evolutions and books on GNSS are rapidly outdated and incorrect information is scattered over the internet.

- In this context, NAVIPEDIA is launched by ESA aiming at **having a single entry point GNSS educational portal** (or wiki) to support the transfer of GNSS know-how providing a common, complete and trustable compilation of reference updated knowledge in GNSS.

- NAVIPEDIA **is conceived as a collaborative GNSS on-line encyclopedia** with the objective to foster the transfer of knowledge in the field of GNSS.

- NAVIPEDIA is an ESA initiative in the context of the EGEP ESA Program **freely accessible to the public**

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# NAVIPEDIA: Users

**NAVIPEDIA potential users include**:

- GNSS-related institutions;
- GNSS industries and involved professionals;
- GNSS present and potential future users;
- GNSS present and potential future service providers;
- Academic environment (i.e. Educators and students; Universities and Schools);
- The general public interested on GNSS.

In order to cover these different needs, all articles in NAVIPEDIA have been **categorized in three different levels**:

- **Basic** – aiming at the general public without technical knowledge of GNSS
- **Medium** – aiming at students, scholars and professionals seeking detailed technical information
- **Advanced** – aiming at scholars and GNSS professionals seeking very detailed technical knowledge on specific aspects of GNSS technology

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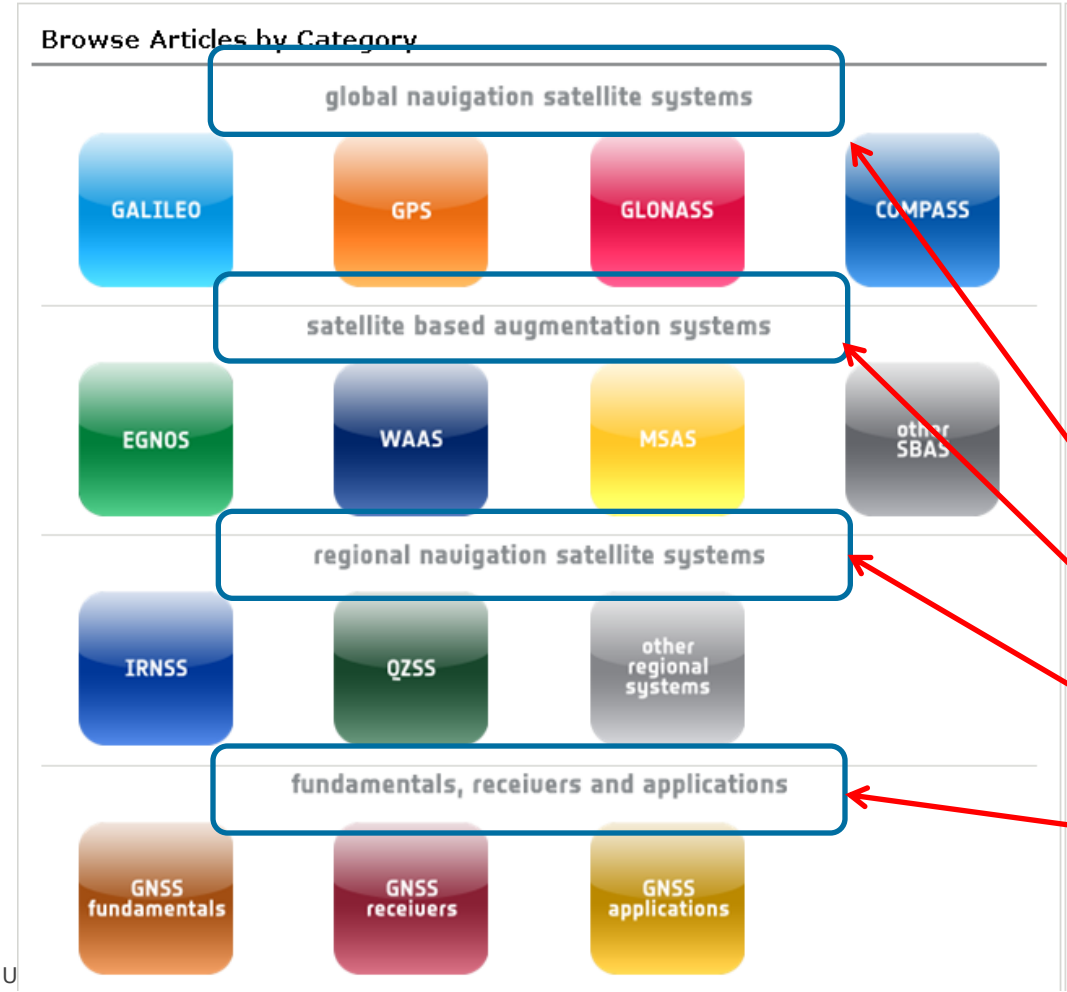
# NAVIPEDIA: ORGANISATION

"The reference for Global Navigation Satellite Systems."

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Main Categories

ESA U

# NAVIPEDIA: ORGANISATION

## Pages in category "Fundamentals"

The following 181 pages are in this category, out of 181 total.

### A

- ARAIM
- Accuracy
- AltBOC Modulation
- An intuitive approach to the GNSS positioning
- Antenna Phase Centre
- Antisymmetric Sequences
- Atmospheric Effects Modelling
- Atmospheric Refraction
- Atomic Time
- Autocorrelation & Power Spectral Density
- Availability

### B

- Bancroft Method
- Best Linear Unbiased Minimum-Variance Estimator (BLUE)
- Binary Coded Symbols (BCS)
- Binary Offset Carrier (BOC)
- Binary Phase Shift Keying Modulation (BPSK)
- Block-Wise Weighted Least Square

### C

- CBCS Modulation
- CDMA FDMA Techniques
- CEP to ITRF
- COMPASS Signal Plan
- Carrier Phase Ambiguity Fixing
- Carrier Phase Cycle-Slip Detection
- Carrier Phase Wind-up Effect
- Carrier phase ambiguity fixing with three frequencies
- Carrier phase ambiguity fixing with two frequencies
- Carrier-smoothing of code pseudoranges
- Cartesian and ellipsoidal coordinates
- Celestial Ephemeris Pole
- Clock Modelling
- Code Based Positioning (SPS)
- Code and Carrier Based Positioning (PPP)

### G cont.

- GALILEO Navigation Message
- GALILEO Signal Plan
- GBAS Fundamentals
- GBAS Standards
- GBAS Systems
- GLONASS Navigation Message
- GLONASS Satellite Coordinates Computation
- GLONASS Signal Plan
- GNSS Augmentation
- GNSS Basic Observables
- GNSS Broadcast Orbits
- GNSS Interference Model
- GNSS Measurement features and noise
- GNSS Measurements Modelling
- GNSS Modulation Schemes
- GNSS Performances
- GNSS Satellites Orbit
- GNSS signal
- GNSS systems description
- GPS C1, P1 and P2 Codes and Receiver Types
- GPS Navigation Message
- GPS Signal Plan
- GPS and Galileo Satellite Coordinates Computation
- Gaussian Minimum Shift Keying (GMSK)
- Generic BCS Signals
- Geometric Range Modelling
- Ground-Based Augmentation System (GBAS)

### H

- Hard Limiting

### I

- ICRF to CEP
- IRNSS Signal Plan
- Instrumental Delay
- Integrity

### P cont.

- Power Spectral Density of Sine-phased BOC signals
- Power Spectral Density of the AltBOC Modulation
- Power Spectral Density of the CBCS Modulation
- Precise GNSS Satellite Coordinates Computation
- Precise Point Positioning
- Precise modelling terms for PPP
- Principles of Compatibility among GNSS
- Principles of Interoperability among GNSS

### Q

- QZSS Signal Plan
- Quadrature Product Sub-carrier Modulation

### R

- RAIM
- RAIM Algorithms
- RAIM Fundamentals
- RTK Fundamentals
- RTK Standards
- RTK Systems
- Real Time Kinematics
- Receiver Antenna Phase Centre
- Receiver noise
- Reference Frames in GNSS
- Reference Systems and Frames
- Regional Datums and Map Projections
- Relativistic Clock Correction
- Relativistic Path Range Effect

### S

- SBAS Fundamentals
- SBAS General Introduction
- SBAS Standards
- SBAS Systems
- Satellite Antenna Phase Centre

# NAVIPEDIA: Article example

esa

esa navipedia

European Space Agency

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## MBOC Modulation

**Contents** [hide]


1 MBOC modulation definition and analysis
2 Implementing MBOC
3 On MBOC and Antisymmetric sequences
4 MBOC Tracking Sensitivity
4.1 Code Tracking Sensitivity
4.1.1 Effect of longer integrations on code tracking sensitivity
4.1.2 Signal structure and DLL code tracking error
4.1.3 Signal structure and DLL sensitivity
5 MBOC Interference with other GNSSes
6 References
7 Credits


**fundamentals**

| | |
|---|---|
| **Title** | MBOC Modulation |
| **Author(s)** | J.A Ávila Rodríguez, University FAF Munich, Germany. |
| **Level** | Advanced |
| **Year of Publication** | 2011 |

## MBOC modulation definition and analysis

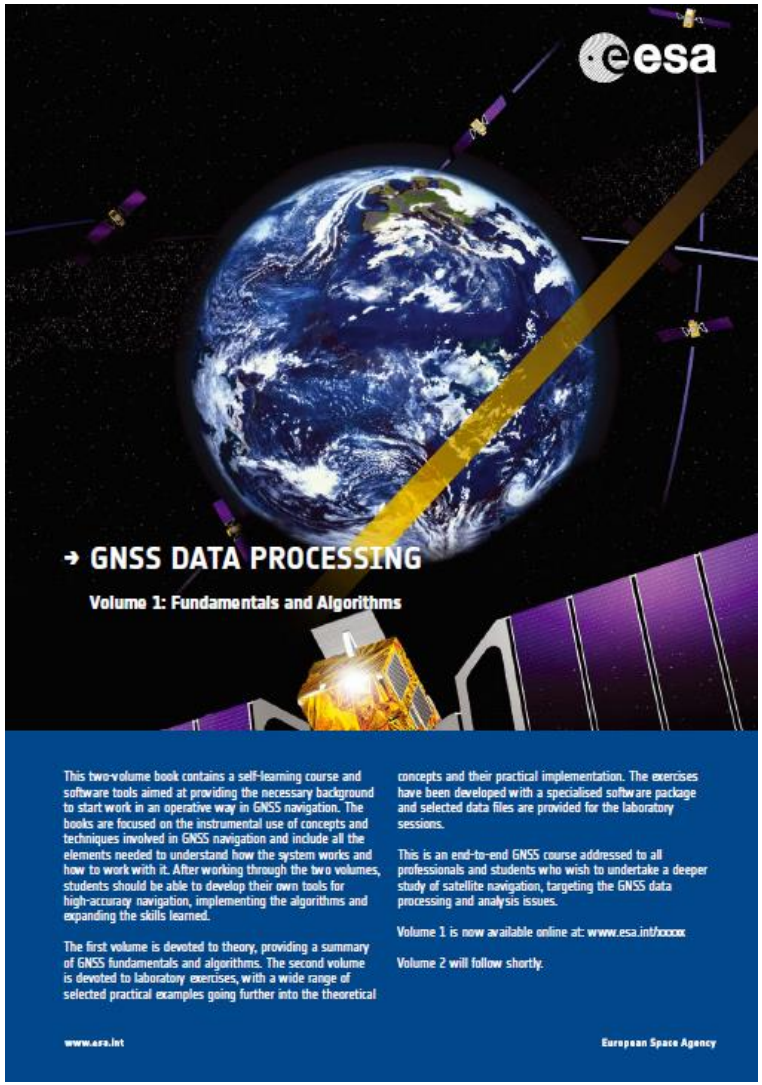
Nearly twenty months after the EU and the US signed the Agreement on the Promotion, Provision and use of Galileo and GPS Satellite-Based Navigation Systems and Related Applications an optimized signal waveform named MBOC (Multiplexed Binary Offset Carrier modulation) was proposed by a common group of experts of the EU and US for GPS L1C and Galileo E1 OS [G.W. Hein et al., 2006a][1], [G.W. Hein et al., 2006b] [2] and [J.-A. Avila-Rodriguez et al., 2006d] [3].

Except for the fact that the CBCS definition requires Interplex to multiplex all the signals, the MBOC modulation can be seen a particular case of the CBCS solution where the BCS sequence adopts the known sine-phased BOC-like form. In this sense, MBOC(6,1,1/11) could also be expressed as CBCS([1,-1,1,-1,1,-1,1,-1,1,-1,1,-1],1,1/11) if the requirement on the Interplex Multiplexing were abandoned. The main objective of the common GPS and Galileo signal design activity was that the PSD of the proposed solution would be identical for GPS L1C and Galileo E1 OS when the pilot and data components are computed together. This assures a high interoperability between both signals. This normalized (unit power) power spectral density, specif

# NAVIPEDIA: Access to a large number of Education material on GNSS

ESA NAVIPEDIA allows also to access a large number of educational material produced by ESA, among which:

- Access on line to the **ESA ESA GNSS Data Processing Book** - TM-23: this two-volume book contains a self-learning course and software tools aimed at providing the necessary background to start work in an operative way in GNSS navigation.
- **GLAB tool** which performs precise modeling of GNSS observables (pseudorange and carrier phase
- **SBAS dedicated education tools**:
  - SBAS Simulator
  - SBAS teacher SBAS mentor
  - SiSnetLab
  - EGNOS toolkit

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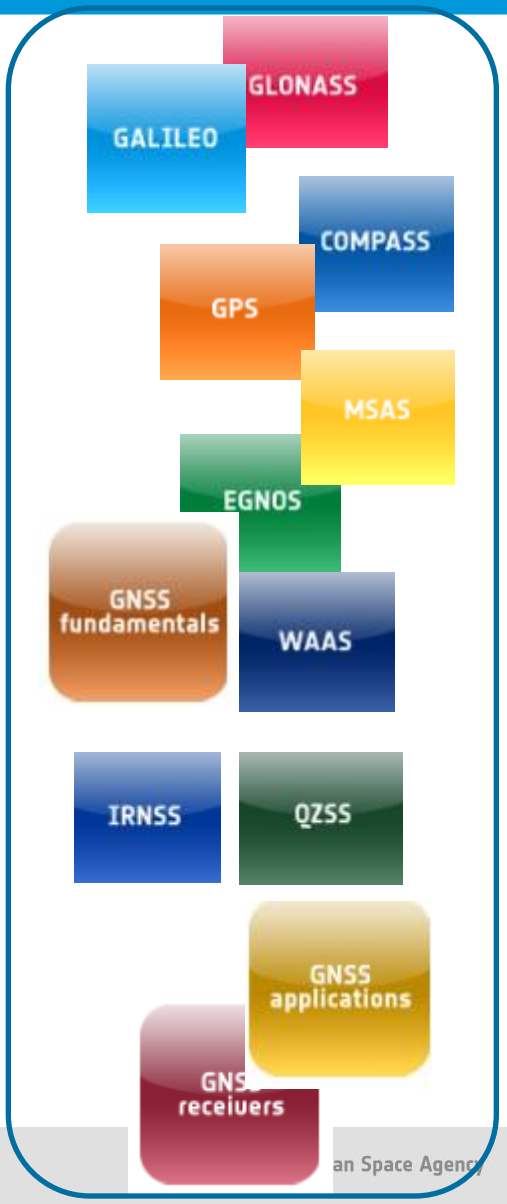
# NAVIPEDIA: Status

- In line with ICG2012 recommendation on NAVIPEDIA, ESA has been maintaining and developing further NAVIPEDIA with up-to-date information.
- NAVIPEDIA is today extensively used by universities and Galileo application developers.
- NAVIPEDIA is also used as reference as part of the European Satellite Navigation Conference (ESNC) for the GNSS application developers
- An APP version of NAVIPEDIA (for both Android and iOS operational systems) is currently under development. This should be ready by the end of 2016.
- By October 2016, **more than 1 million visits** received on NAVIPEDIA website so far s(www.navipedia.org)
- Most visited articles are on GNSS fundamentals and GNSS applications.

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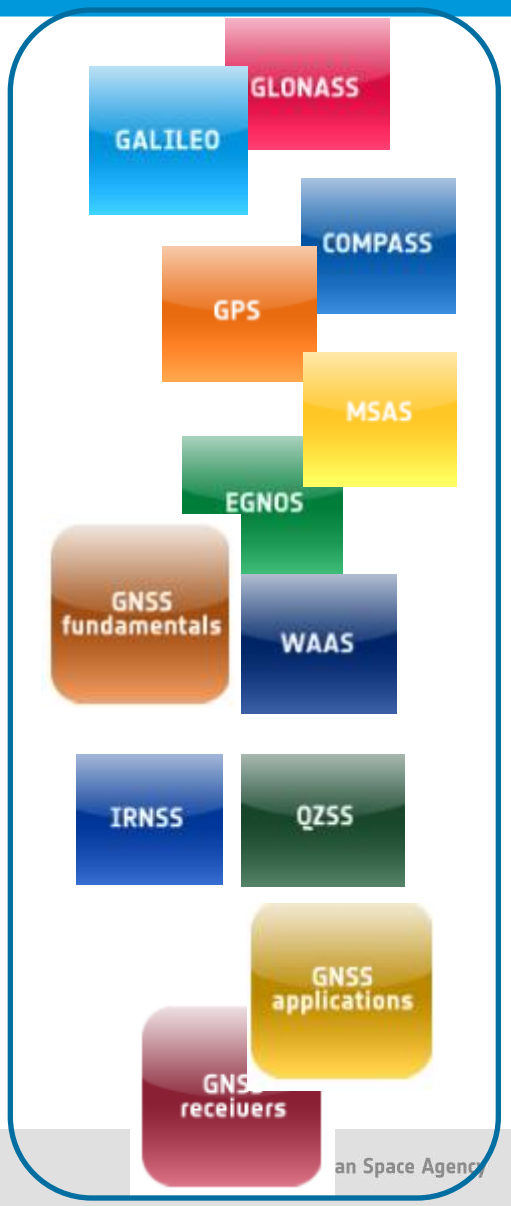
# NAVIPEDIA and ICG

- ESA is pleased to offer NAVIPEDIA as a solid and global reference in GNSS education.

- ESA encourages the ICG Community to participate in the further development of NAVIPEDIA by reviewing and contribu[illegible]nd to pro[illegible]of NAVIPEDI[illegible]al activities.

ICG International Committee on Global Navigation Satellite Systems