



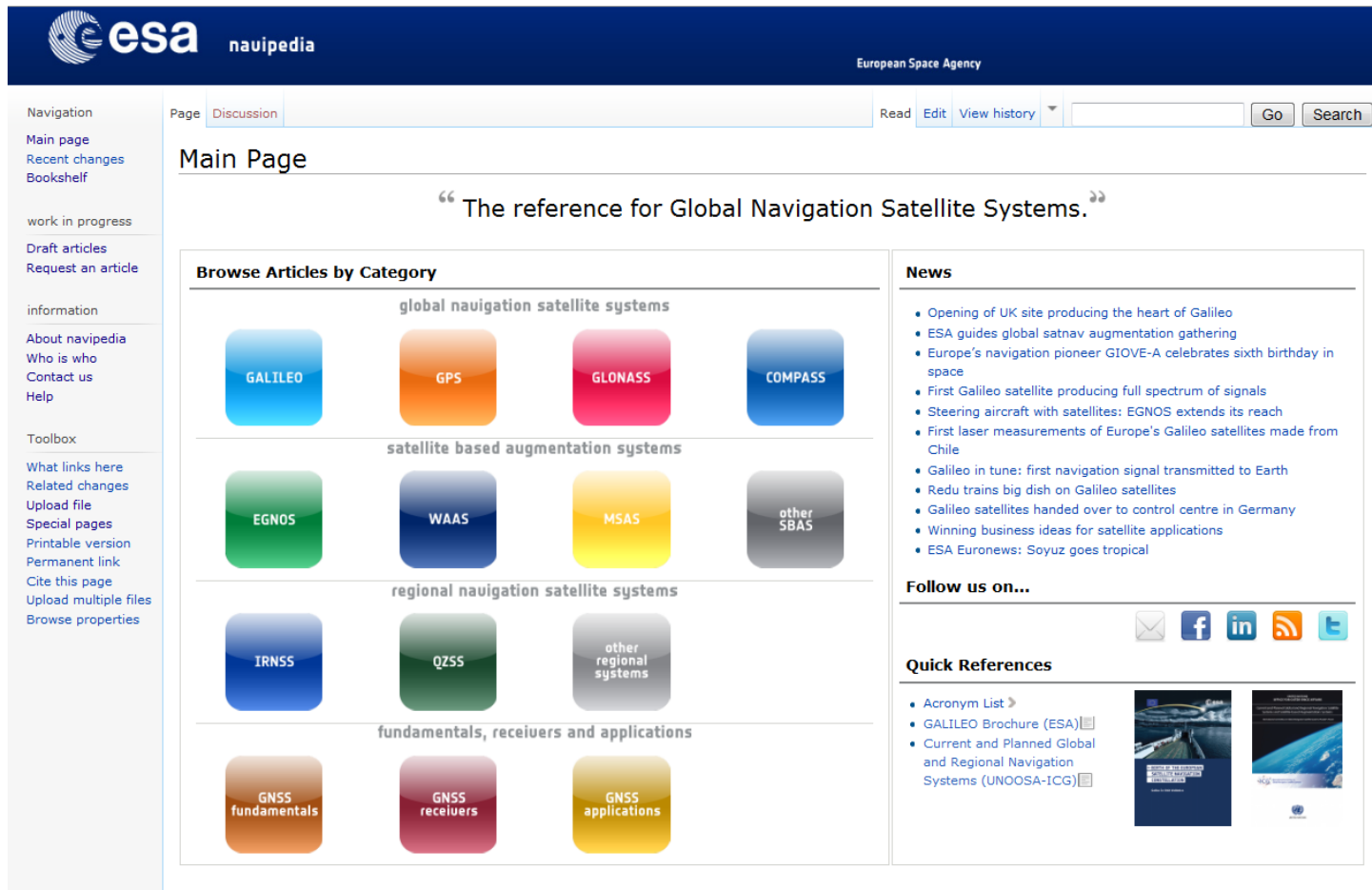
# NAVIPEDIA

“The reference for Global Navigation Satellite Systems”

**Javier Ventura-Traveset**  
**José Angel Avila-Rodriguez**  
**Carlos López de Echazarreta**

NAVIPEDIA is an ESA's initiative (EGEP) aiming at becoming the reference for GNSS general knowledge on the Internet.

[www.nalopedia.org](http://www.nalopedia.org)



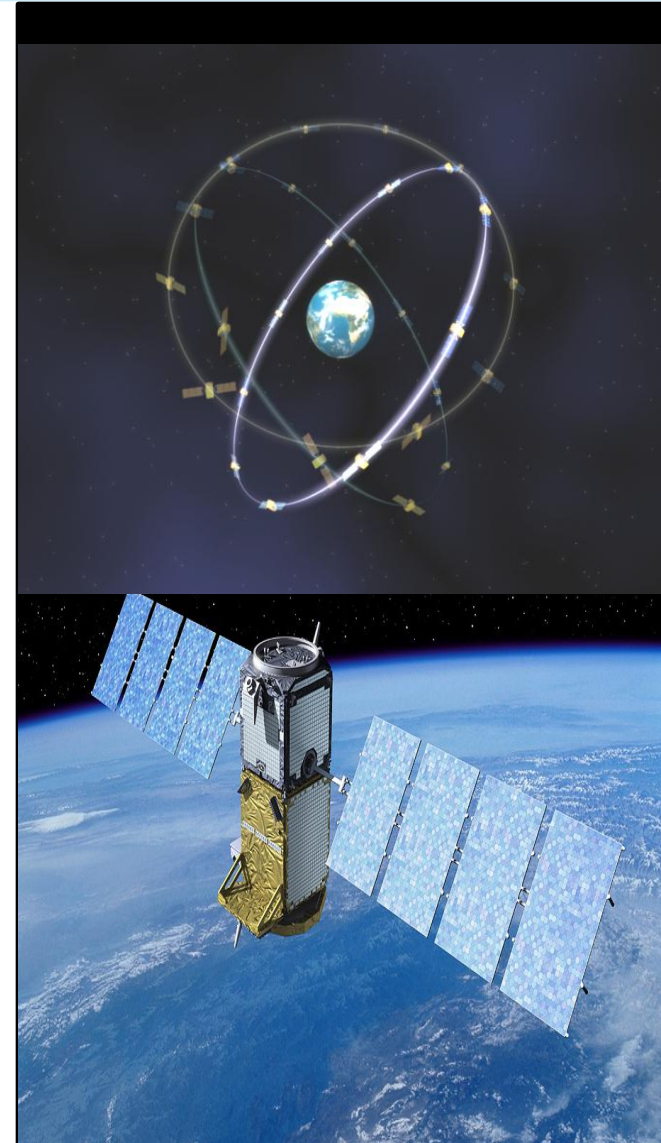
The screenshot shows the NAVIPEDIA website interface. At the top, there is a dark blue header with the ESA logo and the text "naupedia" and "European Space Agency". Below the header, there is a navigation bar with "Page" and "Discussion" tabs, and a search bar with "Go" and "Search" buttons. The main content area is titled "Main Page" and features a quote: "The reference for Global Navigation Satellite Systems." Below the quote, there is a section titled "Browse Articles by Category" with four rows of buttons: "global navigation satellite systems" (GALILEO, GPS, GLONASS, COMPASS), "satellite based augmentation systems" (EGNOS, WAAS, MSAS, other SBAS), "regional navigation satellite systems" (IRNSS, QZSS, other regional systems), and "fundamentals, receivers and applications" (GNSS fundamentals, GNSS receivers, GNSS applications). To the right of the "Browse Articles by Category" section is a "News" section with a list of articles, including "Opening of UK site producing the heart of Galileo" and "ESA guides global satnav augmentation gathering". Below the "News" section is a "Follow us on..." section with social media icons for email, Facebook, LinkedIn, RSS, and Twitter. At the bottom right is a "Quick References" section with a list of links, including "Acronym List" and "GALILEO Brochure (ESA)".

# NAVIPEDIA: Why?



[www.nauipedia.org](http://www.nauipedia.org)

- Proliferation of GNSS: The current GNSS international scenario is very dynamic, including the modernization of the legacy GPS and GLONASS as well as the emergence of new satellite navigation systems including Galileo in Europe and COMPASS in China, but also Satellite Based Augmentation and Regional satellite systems.
- Satellite navigation is progressing at such a rapid pace that it is difficult to keep track of the latest evolutions, satellite launches, technologies or even systems and signals. Furthermore, books on GNSS are rapidly outdated and incorrect information can be found scattered over the internet.
- **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 to the public, providing a common, complete and trustable compilation of reference updated knowledge in GNSS.**

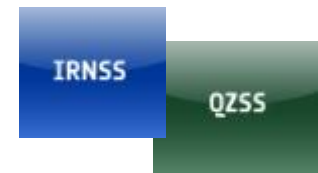


# NAVIPEDIA: Mission (1/2)



[www.nauipedia.org](http://www.nauipedia.org)

- **Foster the transfer of knowledge:** the main mission of NAVIPEDIA is to foster the transfer of knowledge in the field of GNSS. NAVIPEDIA enables users to access updated information of the existing GNSS systems, applications, receivers and fundamentals.
- **Reliable GNSS knowledge generated by best GNSS experts worldwide:** NAVIPEDIA adopts the concept of wiki products - anyone can comment, propose modification to an existing article, suggest a new topic or submit a draft article. However, **NAVIPEDIA differs from other wikies: there is a robust content management that ensures the quality, reliability and consistency of the stored GNSS information.**



[www.nauipedia.org](http://www.nauipedia.org)

# NAVIPEDIA: Mission (2/2)



[www.nauipedia.org](http://www.nauipedia.org)

- NAVIPEDIA is conceived as a collaborative GNSS encyclopaedia with the objective to foster the transfer of knowledge in the field of GNSS.
- NAVIPEDIA is then built on a web-based software platform hosted in a repository server and it is freely accessible to the public.
- The design of the platform considered usability aspects such as learnability, efficiency as well as completeness and correctness of the contents.



[www.nauipedia.org](http://www.nauipedia.org)

- NAVIPEDIA content development priorities remain, being focused on:
  - **Who:** GNSS
  - **Where:** Globally
  - **What:** GNSS Systems, GNSS Fundamentals, GNSS Applications, GNSS Receivers
  - **GNSS Community:** General users, University, GNSS expert users, GNSS Industry, and GNSS Application developers
- NAVIPEDIA is then organized in the following categories:
  - **Global Navigation Satellite Systems**
  - **Satellite Based Augmentation Systems**
  - **Regional Navigation Satellite Systems**
  - **GNSS fundamentals**
  - **GNSS receivers**
  - **GNSS applications**

# NAVIPEDIA: Organisation (2/3)



www.navipedia.org

“ The reference for Global Navigation Satellite Systems. ”

## Browse Articles by Category

### global navigation satellite systems



### satellite based augmentation systems



### regional navigation satellite systems



### documents, standards and regulations



## News

- Galileo Programme Press Briefing at ILA Berlin Air and Space Show 2012
- Countdown: a month to go to Galileo's next launch
- Fourth Galileo satellite reaches French Guiana launch site
- 50 years of space for Norway
- Next Galileo satellite reaches French Guiana launch site
- Mission accomplished, GIOVE-B heads into deserved retirement
- Space signal demonstrates Galileo interoperability with GPS
- ESA extends its navigation lab in readiness for Galileo testing

## Quick References

- Acronym List >
- GALILEO Brochure (ESA)
- Current and Planned Global and Regional Navigation Systems (UNOOSA-ICG)



www.navipedia.org



## 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

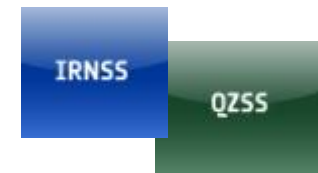
- RAIM
- RAIM Algorithms
- RAIM Fundamentals
- RTK Fundamentals
- RTK Standards
- RTK Systems
- Real Time Kinematics
- Receiver Antenna Phase Centre
- Receiver noise
- Reference Frames in GNSS
- Reference Systems and Frames
- Regional Datums and Map Projections
- Relativistic Clock Correction
- Relativistic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

### S

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



- NAVIPEDIA potential users include: GNSS-related institutions; GNSS involved professionals; GNSS actual and potential users; GNSS actual and potential service providers; academic environment (i.e. Educators and students; mainly from Universities); and the general public interested on GNSS. This group of potential users has very different needs.
- 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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## MBOC Modulation

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- 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]<sup>[1]</sup>, [G.W. Hein et al., 2006b]<sup>[2]</sup> and [J.-A. Avila-Rodriguez et al., 2006d]<sup>[3]</sup>.

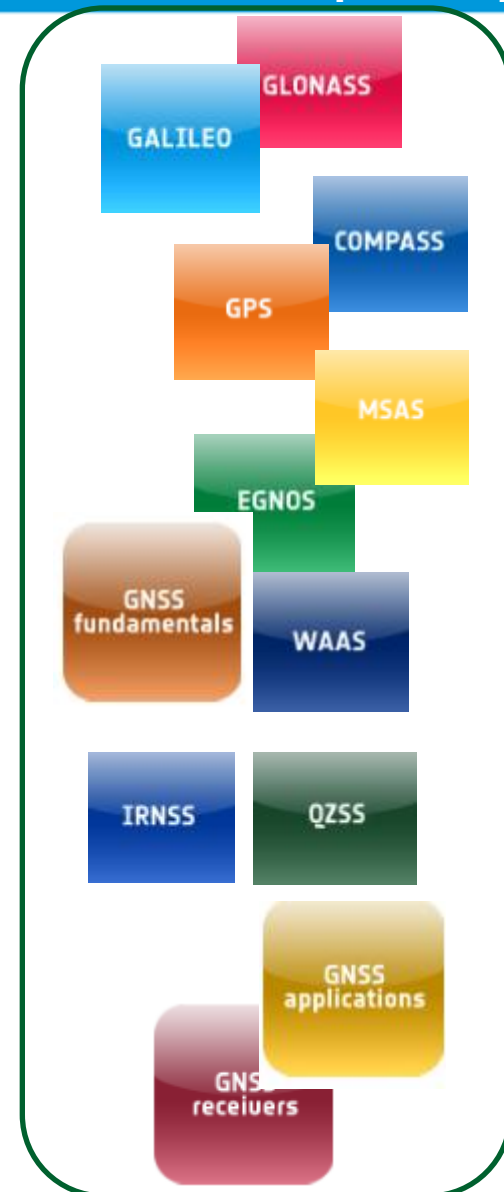
Except for the fact that the CBCS definition requires Interplex to multiplex all the signals, the MBOC modulation can be seen a particular case of the CBCS solution where the BCS sequence adopts the known sine-phased BOC-like form. In this sense, MBOC(6,1,1/11) could also be expressed as CBCS([1,-1,1,-1,1,-1,1,-1,1,-1,1,-1],1,1/11) 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: Summary



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- NAVIPEDIA is a common entry point for GNSS know-how that enables users to access updated information on the existing GNSS Systems, applications, receivers and fundamentals. NAVIPEDIA aims at becoming a reference for GNSS general knowledge on the Internet.
- NAVIPEDIA adopts the concept of Media-wiki products - anyone can comment, propose modification to an existing article, suggest a new topic or submit a draft article. However, there is an important difference that distinguishes NAVIPEDIA from other wikies: **a robust content management and control process ensures the required quality, reliability and consistency of stored GNSS information.**
- NAVIPEDIA follows a collaborative philosophy. Any contribution/partnership is very welcome. This may be done through the official NAVIPEDIA site where anyone can register as user: [www.nauipedia.org](http://www.nauipedia.org)





**THANK YOU**

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