

20 Years of IOMAC

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ABSTRACT

IOMAC was established in 2005, turning 20 years in 2025. This paper is a summary of the most important events related to IOMAC during the last 20 years.



1. WHY IOMAC WAS CREATED

The IOMAC conference was created as the background theories of operational modal analysis (OMA) had started to take shape. The name OMA had been defined by Leuven Measurement Systems (LMS, later Siemens Labs), and the other attempts to name the field, like “ambient response analysis” and “natural input modal analysis” was about to disappear, and both LMS and Structural Vibration Solution (SVS) had developed commercial software solutions for practical applications.

Therefore, a Danish initiative was taken by SVS and Brüel and Kjær (B&K) around 2003 to 2004, to start the IOMAC conference, and it was decided that the conference should take place every second year in spring around May and include both a conference course on the basic theory and a few days of presentations including exposition from the industries with sensors and OMA software.

The driving force in this development were modal analysis technicians from B&K such as Nis Møller, Svend Gade, Henrik Herlufsen and Niels Jørgen Jacobsen, as well as Palle Andersen from SVS together with Rune Brincker from Aalborg University.

There was a strong interest for the new conference from around the world, even though the main interest was from Europe. In the first years we invited our colleagues to the IOMAC scientific committee, and many joined the committee and strengthened the interest for the new scientific area.

It was decided that the first conference should be arranged in Copenhagen. The two companies B&K and SVS guaranteed the budget of around 20.000 EUR.



Figure 1. Logo of the IOMAC conference; IOMAC website

2. 1ST IOMAC 2005, COPENHAGEN (DENMARK)

The first conference was held at the Hotel Admiral (Figure 2), a very nice and well-placed hotel in the middle of the center in Copenhagen, from April 26-27, 2005. The cover of the Proceedings is shown in Figure 3.



Figure 2. Venue of the 1st, 2nd and 8th IOMAC conferences. Hotel Admiral. Copenhagen. Denmark.

The conference published 75 papers, had 5 exhibitors and 120 participants. The keynote with the title “*From Input-Output to Input-Only Modal Identification of Civil Engineering Structures*” was given by Alvaro Cunha, and the Lecture of Honor with the title “*A Personal History of Random Data Analysis*” was given by Julius Bendat due to his great contributions to his theories of random vibrations.

Two conference courses were given, one by Julius Bendat and Kjell Ahlin with the title “Identification and Simulation of Nonlinear Systems” and one by Carlos Ventura and Svend Gade with the title “Modal Identification of Output-Only Systems”.

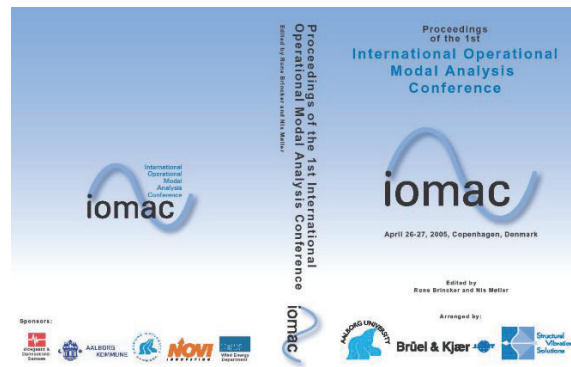


Figure 3. Cover of the Proceedings of the 1st conference 2005.

3. AN INITIAL IDEA OF IOMAC WORKSHOP 2006, AALBORG (DENMARK)

A part of the initial idea was also to arrange a smaller workshop every second year in between the big conference events. Therefore, a smaller event was arranged at Aalborg University by Rune Brincker on May 4-5, 2006, and 14 papers were published. However, the workshop never became as popular as the conferences, and no new editions of the workshop were organized.

4. 2ND IOMAC 2007, COPENHAGEN (DENMARK)

The second IOMAC was arranged again at the Admiral Hotel in Copenhagen, April 30 to May 2, 2007. This time there were 86 papers published and around 100 participants. The pre-conference course on Operational Modal Analysis was instructed by Carlos Ventura and Svend Gade.

The Lecture of Honor with the title “*Back to the future of stochastic subspace identification*” was given by Bart De Moor, and the Keynote Lecture with the title “*The Development of Modal Testing Technology for Wind Turbines*” was given by Thomas G. Carne and George H. James.

5. 3RD IOMAC 2009, PORTONOVO (ITALY)

The third conference was held at the Hotel Excelsior La Fonte in Portonovo (Ancona, Italy), May 4-6, 2009. The conference was jointly organized by Università Politecnica delle Marche, University of L’Aquila, Politecnico di Milano, University of Southern Denmark, Brüel & Kjær and Structural Vibration Solutions. Francesco Benedettini (University of L’Aquila) and Carmelo Gentile (Politecnico di Milano) served as co-chairs of the Organizing Committee.

The conference took place less than one month after the destructive L’Aquila earthquake (April 6, 2009) and a post-conference visit in the earthquake areas was organized for a limited number of attendants by Francesco Benedettini, who was teaching in L’Aquila.

The published proceedings included 98 papers and about 130 people attended the conference. The Lecture of Honor, with the title “*The Trouble with Vibration Measurements ...*” was delivered by David J. Ewins, whereas the Keynote Lecture “*Real-time performance tracking on a 183 m concrete chimney and tuned mass damper system*” was given by James M.W. Brownjohn.

The conference included, for the first time in the IOMAC series, several organized special sessions, focusing on both Civil and Mechanical Engineering: OMA application in bridges and special structures (A. Cunha), OMA for mechanical and aerospace structures (G. Coppotelli, A. Sestieri), Analytical redundancy in damage characterization (D. Bernal), OMA for vibro-acoustic analysis and applications (F. Marulo, E.P. Tomasini) and OMA for monuments and historical constructions (C. Gentile, F. Benedettini).

6. 4TH IOMAC 2011, ISTANBUL (TURKEY)

The fourth IOMAC was arranged in Istanbul (Turkey), May 9-11, 2011. The chairs of the conference were Erdal Şafak and Temel Belek. A pre-conference course was organized on May 9 and the instructors were Carlos Ventura and Svend Gade.

The Lecture of Honor with the title “*Expanding the Borders of Operational Modal Analysis*” was given by Guido de Roeck (K.U. Leuven) and the Keynote Lecture with the title “*Non-Stationary Random Vibration Modelling and Identification: an overview of parameteric methods and applications*” was given by Spilios Fassois (University of Patras).

7. 5TH IOMAC 2013, GUIMARÃES (PORTUGAL)

The fifth IOMAC was arranged in Guimarães (Portugal), May 13-15, 2013. The chairs of the conference were Álvaro Cunha (University of Porto) Luis Ramos (University of Minho). A pre-conference course was organized on May 13 instructed by Carlos Ventura and Svend Gade.

The Lecture of Honor with the title “*Experimental Modal Analysis Under Ambient Excitation: What We Can Learn from Experience*” was given by Reto Cantieni (RCI Dynamics) and the Keynote Lecture with the title “*Combined Use of Operational Testing and Models Throughout the Product Lifecycle*” was given by Bart Peeters (LMS International)

8. 6TH IOMAC 2015, GIJÓN (SPAIN)

The sixth edition of IOMAC was held in the city of Gijón (Spain) from May 10-14, 2015. The chair of this edition was Manuel Aenlle, and the conference was jointly organized by the university of Oviedo and the Technical University of Madrid. This edition was the first time that IOMAC was running for three days.

This edition of IOMAC was dedicated, in memoriam, to Prof. Francesco Benedettini who passed away in February 2015. He has been an active member of the IOMAC Scientific Committee and served as a chair of the conference in 2009 and as the chair of the Permanent Committee since May 2013.



Figure 4. The participants in front of the conference venue. Hotel Abba. Gijón (Spain).

A pre-conference course was also organized on May 10 and 11 at the facilities of University of Oviedo. Carlos Ventura and Svend Gade were the instructors, dedicating the first day to theory, and the second day to experimental tests and modal analysis.

Two Keynote Lectures were given at this conference:

- ***OMA On Operating Wind Turbines: Challenges and Solutions***, by Dmitri Tcherniak (Brüel & Kjær, Denmark)
- ***Implications of Closely Spaced Modes in OMA***, by Rune Brincker (Aarhus University).

The Lecture of Honor was given by Havard Vold (Ata Engineering Inc., San Diego, USA), who presented “*The Rock Crusher That Also Crushed Bearings*”



Figure 5. Pre-conference course at the University of Oviedo.

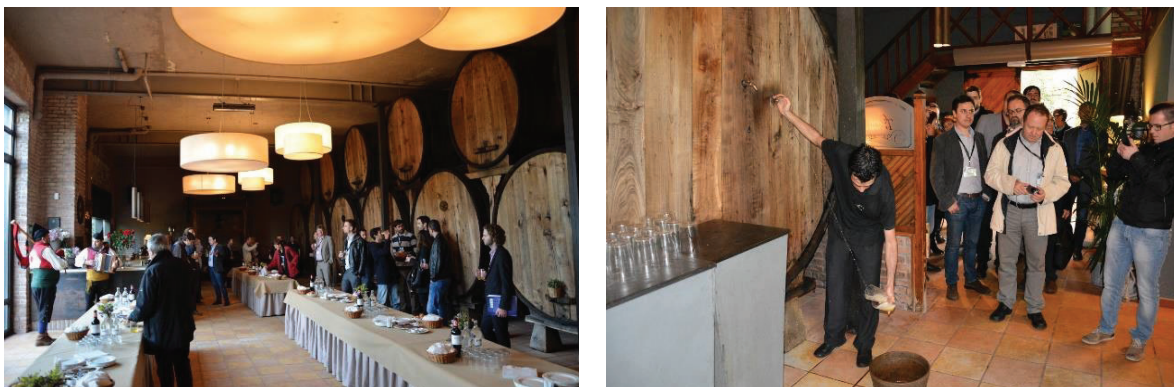


Figure 6. Conference dinner at “Llagar Trabanco”, Gijón.

9. 7TH IOMAC 2017, INGOLSTADT (GERMANY)

The THI and Ingolstadt welcomed the seventh IOMAC from May 10-12, 2017. The chair of this edition was Jörg Bienert. Nestled along the beautiful Danube River and situated in the heart of Bavaria, Ingolstadt offered a unique blend of historical significance and modern prosperity. This vibrant city is renowned as the birthplace of the Bavarian Purity Law for beer, established in 1516, which continues to influence brewing traditions worldwide.

Ingolstadt is also home to Bavaria's first university, founded in 1472, which later evolved into the prestigious Ludwig Maximilian University (LMU) in Munich. Today, the city maintains its academic spirit with the Technische Hochschule Ingolstadt (THI), a leading institution in driving research and innovation in engineering and technology.

Beyond academia, Ingolstadt stands as a symbol of industrial excellence, hosting the headquarters and main production site of Audi, a global leader in automotive engineering. This combination of historical heritage, academic capability, and technological advancement makes Ingolstadt a dynamic and inspiring destination for the international guests of IOMAC.



Figure 7. Opening of the 7th IOMAC conference.



Figure 8. Ship tour from Weltenburg to Kelheim.

The conference was in line with the traditional scheme on IOMAC. The different sessions hosted more than 50 scientific paper presentations. The program was enriched with three Keynote Lectures:

- *New Concepts for Ground and Flight Vibration Testing of Aircraft Based on Output-Only Modal Analysis*, Dr. Marc Böswald (DLR, Göttingen)
- *Development of a Deflection Monitoring System for Wind Turbine Blades*, Prof. Masaaki Okuma (Tokio Institute of Technology, Japan)
- *Predicting In-Operation Dynamics by Assembly of Measured Components*, Prof. Daniel Rixen (Technical University Munich)

10. 8TH IOMAC 2019, COPENHAGEN (DENMARK)

This IOMAC was a re-visit of the two first IOMAC in Copenhagen. Again, the conference was at the Admiral Hotel, May 12-15. We used the same lecture rooms and the same exhibition area as in 2005 and 2007. This time 81 papers were published, with 101 participants and 7 exhibitors.

The Lecture of Honor was given by Svend Gade: “*35 Years of Modal Analysis*”, and the Keynote Lecture was given by Carmelo Gentile: “*Application of OMA on historical buildings and bridges*”. Five special sessions were also arranged at this conference.

11. 9TH IOMAC 2022, VANCOUVER (CANADA)

The 9th edition of the IOMAC Conference was held in the city of Vancouver (Canada) from July 3-6, 2022. The chair of this edition was Carlos Ventura. This conference was postponed for one year due to the COVID-19 pandemic.

The Lecture of Honor with the title “*SHM in a Seismic Environment*” was given by Rubén Boroscheck (University of Chile) and the Keynote Lecture with the title “*New Approaches to Analyze Vibration Records from Buildings*” was given by Erdal Şafak (Bogazici University in Istanbul).



Figure 9 Conference Venue. Sheraton Vancouver Wall Centre.

12. 10TH IOMAC 2024, NAPLES (ITALY)

The 10th conference was held at Villa Doria d'Angri (Figure 10), one of the most important neoclassical villas, located on the Posillipo hill in Naples, Italy. The chair and co-chair of this edition were Carlo Rainieri (National Research Council of Italy) and Carmelo Gentile (Politecnico di Milano). The conference attracted 140 papers published in two volumes by Springer.



Figure 10 View of Villa Doria d'Angri, venue of IOMAC 2024

The technical program holding 144 technical presentations, 2 keynote lectures and a lecture of honor attracted more than 200 participants from the five continents, with a majority of European people. The conference was supported by 20 sponsors and hosted 17 exhibitor booths.

The Lecture of Honor was given by Elsa Caetano: “***Vibration testing avenues: from ground to roof***”, while the keynotes were given by Edwin Reynders (“***Operational modal analysis and structural health monitoring with fiber-optic strain sensors***”) and Filippo Ubertini (“***Advancing structural health monitoring: embracing a territorial perspective***”). 10 special sessions were also arranged at this conference.

Three social events (Figure 11) complemented the conference program, which also hosted an event dedicated, in memoriam, to Dr. Reto Cantieni, who passed away in April 2022.



Figure 11 Gala Dinner

13. 11TH IOMAC 2025, RENNES (FRANCE)

Being the first time in France, the 11th edition was held at Inria, the French National Institute for Research in Digital Science and Technology, in Rennes, from May 20-23, 2025. The conference chair was Michael Döhler (Inria).

After a few years break, the pre-conference courses were again part of the conference. The course *“Operational Modal Analysis: Background, Theory & Practice”* was held by Carlos Ventura and Niels-Jørgen Jacobsen, and a new course *“Advanced Methods for Vibration Analysis”* was held by Szymon Greś and Alexander Mendler; both with high appreciation.



Figure 12 Pre-conference course



Figure 13 Auditorium at Inria’s conference center

The technical program had 90 accepted papers, and included 11 special sessions highlighting some new directions of OMA related developments – ranging from Bayesian inference in engineering dynamics and computational methods to physics-enhanced learning and digital twin frameworks, amongst many others. The Lecture of Honor was given by Spilios Fassois (University of Patras): *“Time series based robust damage and fault diagnosis for structures and systems under uncertainty”*. The keynote lecture *“Structural dynamics as a principal pillar to AI-enhanced digital twinning”* was given by Eleni Chatzi (ETH Zürich), and two industrial keynotes *“Dynamic computational model and health monitoring of gas turbines for helicopters”* and *“Operational Modal Analysis in aeronautical industry”* were given by Frédéric Batlle (Safran Helicopter Engines) and Fabien Ayme (Airbus). Further program highlights

were a 3-minute PhD pitch competition, as well as an industrial plenary session involving the six exhibitors of the conference.

The scientific program was complemented by a rich social agenda, including a welcome reception and a wine-and-cheese tasting in downtown Rennes. A highlight was the excursion to Mont-Saint-Michel, followed by the gala dinner at the historic Château de Bonnefontaine.



Figure 14 Excursion to Mont-Saint-Michel



Figure 15 Group photo at Château de Bonnefontaine

14. IOMAC CHAIRS

IOMAC is governed by a Permanent Committee formed by a President (Chair), a Vice President (Vice-chair), a secretary, and a number of committee members. In these 20 years, the IOMAC conference has had four chairs:

- Rune Brincker: May 2005-May 2013
- Francesco Benedettini: May 2013-February 2015 (†)
- Carlos Ventura: February 2015-May 2015 (Interim Chair)
- Manuel Aenlle: May 2015-2025



Rune Brincker



Francesco Benedettini



Carlos Ventura



Manuel Aenlle

Figure 16. IOMAC chairs.

15. IOMAC ASSOCIATION

The IOMAC association was created in 2015, and it is based in Gijón (Spain). The aims of the association are to study, analyse, and apply operational modal analysis to all types of structures and mechanical systems. To pursue this aim, the IOMAC shall:

- Promote the generation and dissemination of technical and scientific information within its field of activity, fomenting the teaching and training at all levels of subjects related to operational modal analysis.
- Foment the collaboration and transfer of the results between industry and public as well as private research groups.

- Cooperate with administrations and with the groups, associations, and industrial sectors involved, in the preparation and execution of projects related to modal analysis.
- Work together with other like societies both national and international in the undertaking of said activities.
- Meetings, congresses, conferences, seminars, courses, workshops and exhibitions. In particular, the International Operational Modal Analysis Conference (IOMAC) shall be held every two years.
- Editing (printed or electronic) scientific publications and techniques, bulletins, mailing lists or any other means of dissemination or exchange of scientific and technical information.
- Awarding of financial assistance and prizes.
- General undertaking of any activity that could help in the achievement of the aims set by IOMAC.

16. IOMAC AWARDS

In 2017, the Permanent Committee decided to create the IOMAC awards, which intend to recognize those people who had made significant contributions to the development of operational modal analysis and to the success of the IOMAC Conferences. The award winners have been:

AWARDS 2017

- Alvaro Cunha, University of Porto (FEUP), Portugal
- Rune Brincker, Technical University of Denmark
- James Brownjohn, University of Exeter, UK
- Reto Cantieni, RCI Dynamics, Switzerland
- Carmelo Gentile, Politecnico di Milano, Italy
- Svend Gade, Brüel & Kjær, Denmark

AWARDS 2019

- Carlo Rainieri, University of Molise, Italy
- Helmut Wenzel, Wenzel Consulting Engineers GmbH, Austria

AWARDS 2021

- Guido de Roeck, KU Leuven, Belgium

AWARDS 2024

- Edwin Reynders, KU Leuven, Belgium
- Michael Döhler, Inria, France

AWARDS 2025

- Bart Peeters, Siemens Industry Software, Belgium
- Carlos Ventura, University of British Columbia, Canada

17. OMA GUIDELINES FOR CIVIL ENGINEERING

In the IOMAC conference held in Copenhagen in 2019, it was decided to prepare guidelines focused on OMA of civil engineering structures. Carlo Rainieri (National Research Council of Italy, Construction Technologies Institute) was the coordinator of these guidelines, chairing all the meetings, editing the final document and writing some parts of the guidelines. The final version was issued in July 2023. The guidelines can be freely downloaded from the IOMAC website (https://www.iomac.info/_files/ugd/c19177_5e1572a8baca4889a0bfa8f3b742865c.pdf)

The guidelines provide general recommendations for test planning and execution, criteria for the selection, maintenance, and installation of measurement equipment, for data pre-processing, processing and validation. Moreover, they give an overview of possible post-processing including, among the

others, Finite Element (FE) model updating and modal property tracking for vibration-based Structural Health Monitoring (SHM). These guidelines summarize good practices in order to guide technicians towards field applications of OMA to civil engineering structures.

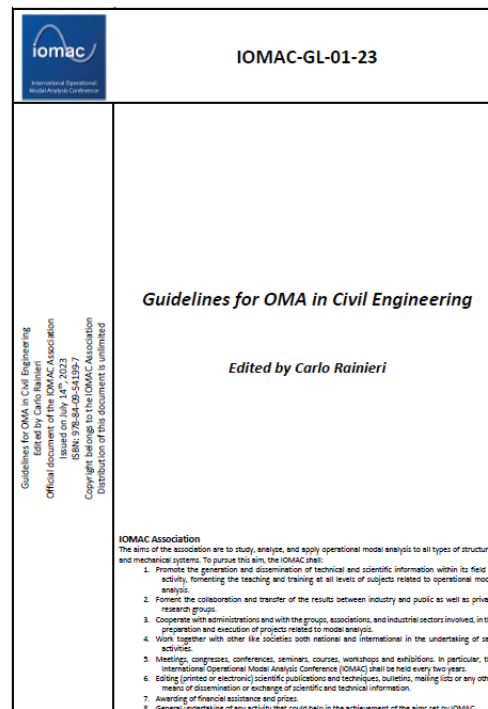


Figure 17. Cover of the guidelines for OMA in civil engineering.

18. IOMAC PROCEEDINGS

A book of proceedings has been prepared in each edition of the conference. A total of 840 papers have been published in the first ten editions of the conference (2005-2024). The papers of all the editions are indexed in scopus. Moreover, since the edition of 2015, the proceedings have also been indexed in the web of science (WOS).

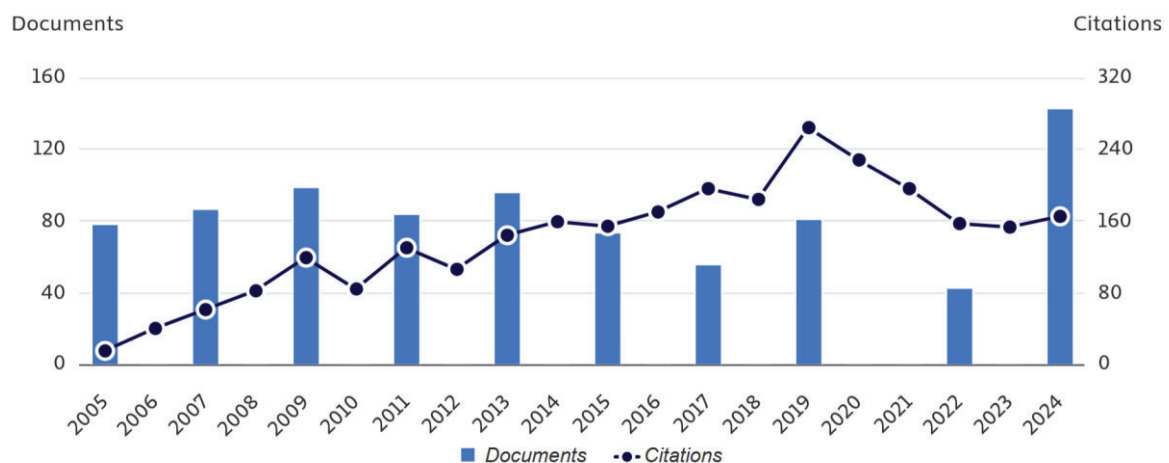


Figure 18. Citations of IOMAC papers according to SCOPUS.

According to SCOPUS (Figure 18), the IOMAC papers have been cited 2826 times (January 2025). The most cited papers are:

- *An overview of operational modal analysis: Major development and issues*. IOMAC 2005. Zhang L., Brincker R., Andersen P., 194 cites
- *PolyMAX: A revolution in operational modal analysis*. IOMAC 2005. Peeters B., Van der Auweraer H., 173 cites.
- *Frequency domain techniques for operational modal analysis*. IOMAC 2005. Gade S., Møller N.B., Herlufsen H., Konstantin-Hansen H., 105 cites.
- *Experimental methods used in system identification of civil engineering structures*. IOMAC 2005. Cantieni R., 92 cites.
- *Removing disturbing harmonics in operational modal analysis*. IOMAC 2007. Peeters B., Cornelis B., Hanssens K., Van der Auweraer. 75 cites.

19. OMA BOOKS

In addition to the papers related to OMA published in conferences and journals, three books specifically focused on OMA have been published:

- ***Operational Modal Analysis of Civil Engineering Structures. An Introduction and Guide for Applications***. Carlo Rainieri, Giovanni Fabbrocino. Springer 2014.
- ***Introduction to Operational Modal Analysis***. Rune Brincker, Carlos Ventura, John Wiley & Sons, Inc., 2015.
- ***Operational Modal Analysis. Modeling, Bayesian Inference, Uncertainty Laws***. Siu-Kui Au. Springer, 2017.

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CONTRIBUTIONS

The content of this paper has been written by:

- Rune Brincker: sections 1, 2, 3, 4 and 10.
- Manuel Aenlle: sections: 6-8, 11, 14-18.
- Joerg Bienert: section 9.
- Carmelo Gentile: section 5.
- Carlo Rainieri: sections 12 and 17.
- Michael Döhler: section 13.

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