

Progress in Marine Science and Technology 10

Technology and Science for the Ships of the Future

Proceedings of the 21st International Conference on
Ships and Maritime Research (NAV 2025),
Messina, Italy, 18–20 June 2025



Edited by
Vincenzo Crupi and Vittorio Bucci

 IOS Press



The oceans are a key resource for transportation, energy and material extraction, and food production, representing one of the most important environments on the planet. Technological developments enabling us to exploit marine resources in a sustainable way are therefore of the greatest importance.

This book presents the proceedings of the NAV 2025 conference, held in Messina, Italy, from 18 to 20 June 2025. The conference is held every 3 years, attracting specialists in marine technology from all over the world. NAV 2025 was the 21st edition of the conference, and covered a full spectrum of maritime technology themes, all related to the exploitation of sea resources. The book contains 125 scientific papers, covering subjects ranging from comfort on board; green and smart ships for sustainable navigation; hydrodynamics; marine renewable energies and resources; naval ships and submarines; offshore and underwater technologies; safety and security; ship and yacht design; ship digitalization and autonomous vehicles; ship propulsion, machinery and systems; ship structures and materials; Fincantieri workshop on digitalization and new edge-cloud technologies in the maritime sector.

Providing a comprehensive coverage of the latest scientific and technical maritime issues, the book will be of interest to all those involved in this vital global industry.



TECHNOLOGY AND SCIENCE FOR THE SHIPS OF
THE FUTURE

Progress in Marine Science and Technology

Progress in Marine Science and Technology (PMST) is a peer-reviewed book series concerned with the field of marine science and technology. It includes edited volumes, proceedings and monographs dealing with research in pure or applied science and work of a high international standard on subjects such as: conceptual design; structural design; hydromechanics and dynamics; maritime engineering; production of all types of ships; production of all other objects intended for marine use; shipping science and all directly related subjects; offshore engineering as related to the marine environment; oceanographic engineering subjects related to the marine environment.

Advisory Series Editors:

Peter Wellens, *Technical University Delft, The Netherlands*; Giles Thomas, *University College London, UK*; Gabriele Bulian, *University of Trieste, Italy*;
Cesare M. Rizzo, *University of Genoa, Italy*

Volume 10

Recently published in this series

- Vol. 9. N. Degiuli, M. Valčić, V. Bucci and L. Braidotti (Eds.), *Theory and Practice of Shipbuilding – Proceedings of the 26th Symposium (SORTA 2024), Zadar, Croatia, 2–5 October 2024*
- Vol. 8. A. Marino, S. Bertagna, V. Bucci and L. Braidotti (Eds.), *Nautical and Maritime Culture, from the Past to the Future – Proceedings of the 4th International Conference (CNM 2024), Venice, Italy, 28–29 November 2024*
- Vol. 7. E. Begovic (Ed.), *HSMV 2023 – Proceedings of the 13th Symposium on High Speed Marine Vehicles*
- Vol. 6. E. Rizzuto and V. Ruggiero (Eds.), *Technology and Science for the Ships of the Future – Proceedings of NAV 2022: 20th International Conference on Ship & Maritime Research*
- Vol. 5. E. Begovic (Ed.), *HSMV 2020 – Proceedings of the 12th Symposium on High Speed Marine Vehicles*
- Vol. 4. M.L. Kaminski and P. Rigo (Eds.), *Proceedings of the 20th International Ship and Offshore Structures Congress (ISSC 2018) Volume 3 – Discussions*
- Vol. 3. E. Fasano, A. Scamardella and V. Bucci (Eds.), *Nautical and Maritime Culture, from the Past to the Future – Proceedings of the 3rd International Conference on Nautical and Maritime Culture*
- Vol. 2. M.L. Kaminski and P. Rigo (Eds.), *Proceedings of the 20th International Ship and Offshore Structures Congress (ISSC 2018) Volume 2 – Specialist Committee Reports*
- Vol. 1. M.L. Kaminski and P. Rigo (Eds.), *Proceedings of the 20th International Ship and Offshore Structures Congress (ISSC 2018) Volume 1 – Technical Committee Reports*

ISSN 2543-0955 (print)
ISSN 2543-0963 (online)

Technology and Science for the Ships of the Future

Proceedings of the 21st International Conference on Ships and
Maritime Research (NAV 2025), Messina, Italy, 18-20 June 2025

Edited by

Vincenzo Crupi

University of Messina

and

Vittorio Bucci

University of Trieste

 **Sage**

 **IOS Press**

© 2025 IOS Press.

This book is published online with Open Access and distributed under the terms of the Creative Commons Attribution Non-Commercial License 4.0 (CC BY-NC 4.0).

ISBN 978-1-64368-610-3 (online)
doi: 10.3233/PMST10



IOS Press

A Sage company
Nieuwe Hemweg 6B
1013 BG Amsterdam

Sage
1 Oliver's Yard
55 City Road
London EC1Y 1SP

Sage
2455 Teller Road
Thousand Oaks
California 91320

Sage
Unit No 323-333, Third Floor, F-Block
International Trade Tower
Nehru Place, New Delhi – 110 019

Sage
8 Marina View Suite 43-053
Asia Square Tower 1
Singapore 018960

DISCLAIMER

The authors, editors, and publisher will not accept any legal responsibility for any errors or omissions that may be made in this publication. The publisher makes no warranty, express or implied, with respect to the material contained herein.

Preface

About NAV

The first Conference took place in 1974 as “Convegno Scientifico del Gruppo Automazione Navale e Problemi delle Grandi Navi” (Scientific Conference of Marine Automation Group and Large Vessels Issues), to be held every two years under the patronage of Technical Naval studies Centre (CETENA) and Italian National Research Council (CNR).

In 1984, the cooperation between CETENA and Marine Technical Association (ATENA) led to rename the conference as NAV spreading the topics also to purely technical field, originally covered by ATENA national conferences. Since 1994 the NAV conference is held every three years being the most important Italian forum for scientific and technical maritime community, attracting also specialists from all around the world.

The 21st Conference (NAV 2025) is finally back in Messina, after 15 years. An international scientific Committee, composed by members of international academic institutions and relevant industry sectors, ensures the scientific quality of the conference under the guidance of the chairman, Professor Vincenzo Crupi (University of Messina).

The previous editions: Rome (1974), Naples (1976), Trieste (1978), Genoa (1980), Naples (1982), Venice (1984), Palermo (1986), Trieste (1988), Ancona (1990), Genoa (1992), Rome (1994), Sorrento (1997), Venice (2000), Palermo (2003), Genoa (2006), Messina (2009), Naples (2012), Lecco (2015), Trieste (2018), Genoa (2022).

About ATENA

ATENA (Associazione Italiana di Tecnica Navale) was established in Genoa in 1947 on the initiative of a group of Italian naval architects and marine engineers. Its principal aim was to extend the initiatives of the Collegio degli Ingegneri Navali e Meccanici in such a way as to incentivise the discussion of ship design and maritime industry between the Italian specialists in this sector.

The first Technical National Conference was held in February 1948, attracting contributions from the most representative personalities of the national maritime sector, including professional naval architects and marine engineers, professors, researchers, ship owners and insurers.

Since the foundation of ATENA, its members have been providing high-level contributions to research, ship design & construction, and the shipping industry. A primary focus is also given to other relevant topics such as maritime safety and environmental issues.

Because the maritime industry acts in a global market, ATENA also spreads this vision worldwide by opening its conferences and events to international professionals.

NAV 2025 Organizing Committee

Chairman

- Alberto MOROSO (*ATENA, President*)

Conference Secretary

- Vittorio BUCCI (*ATENA, National Secretary*)

Conference Accountant

- Ernesto FASANO (*University of Naples Federico II – ATENA Treasurer*)

Conference Manager

- Serena BERTAGNA (*University of Trieste – ATENA FVG*)

IT Supervisor

- Luca BRAIDOTTI (*University of Trieste – ATENA FVG*)

Members

- Giovanni ALGA (*ATENA Sicilia Orientale*)
- Valerio RUGGIERO (*University of Messina – ATENA Ligure – Piemontese*)
- Natasha TAUCER MARCHESI (*University of Trieste – ATENA FVG*)

Local Organizing Committee

Members

- Vincenzo CRUPI (*University of Messina*)
- Giuseppe BRANDO (*University of Messina*)
- Giovanni BRIGUGLIO (*University of Messina*)
- Pasqualino CORIGLIANO (*University of Messina*)
- Fabio DISTEFANO (*University of Messina*)
- Gabriella EPASTO (*University of Messina*)
- Benedetto MELE (*University of Messina*)
- Giulia PALOMBA (*University of Messina*)
- Daniele RIZZO (*University of Messina*)

NAV 2025 Scientific Committee

Chairman

- Vincenzo CRUPI (*University of Messina*)

Members

- Marco ALTOSOLE (*University of Naples, Federico II*)
- Nastia DEGIULI (*University of Zagreb*)
- Pingsha DONG (*University of Michigan*)
- Massimo FIGARI (*University of Genova*)
- Yordan GARBATOV (*University of Lisbon*)
- Marilena GRECO (*Norwegian University of Science and Technology*)
- Paola GUALENI (*University of Genova*)
- Carlos GUEDES SOARES (*University of Lisbon*)
- Alessandro IAFRATI (*CNR Institute Director*)
- Claudio LUGNI (*University of Naples, Federico II*)
- Alberto MARINO' (*University of Trieste*)
- Jasna PRPIĆ-ORŠIĆ (*University of Rijeka*)
- Cesare RIZZO (*University of Genoa*)
- Enrico RIZZUTO (*University of Genoa*)
- Antonio SCAMARDELLA (*University of Naples, Parthenope*)
- Michele VIVIANI (*University of Genoa*)

Conference Topics

Topics

- Comfort on Board
- Green and Smart Ships for Sustainable Navigation
- Hydrodynamics
- Marine Renewable Energies and Resources
- Naval Ships and Submarines
- Offshore and Underwater Technologies
- Safety and Security
- Ship Design
- Ship Digitalization and Autonomous Vehicles
- Ship Propulsion, Machinery and Systems
- Ship Structures and Materials
- Yacht Design
- Fincantieri Workshop on Digitalization and New Edge-Cloud Technologies in the Maritime Sector

Peer Review Statement

Number of submitted articles: 142

Number of accepted articles: 125

Acceptance rate: 88%



Proceedings of the 21st International Conference on Ships and Maritime Research

Organized by



Patronages



With the support of

FINCANTIERI



Il sinistino per manutenzione degli eli

NAV 2025, the 21st International Conference on Ships and Maritime Research, was held in Messina (Italy) on June 18th–20th 2025 and organized by ATENA (Associazione Italiana di Tecnica Navale), with the collaboration of the University of Messina.

Contents

Preface	v
About the Conference	vi
Comfort on Board	
Optimal Geometry of ABH-Based Honeycomb Panels for Vibro-Acoustic Control on Board Cruise Ships	2
<i>Giada Kyaw Oo D'Amore, Francesco Mauro, Giovanni Rognoni, Jacopo Bardiani and Marco Biot</i>	
Comparison of Analytical and Experimental Natural Frequencies of a Composite Beam	12
<i>Giuseppe Angelici, Tatiana Pais, Gianmarco Vergassola and Cesare Mario Rizzo</i>	
Suspended Casing: A Novel Installation Solution of the Engine Casing Equipment for Mitigation of Structure-Borne Noise Onboard	21
<i>Filippo M. Mastracci, Federico Gobbo and Andrea Iuliano</i>	
Nonlinear Model-Based Control of a Gyroscopic Stabilization System for High-Speed Crafts	29
<i>Gianluca Pepe, Maicol Laurenza, Giacomo Federici, Silvia Milana and Antonio Carcaterra</i>	
Green and Smart Ships for Sustainable Navigation	
A CFD Based Method to Assess Underwater Venting of Methanol and Nitrogen for Yachts	38
<i>Sara Rasori, Marco Falossi, Filippo Bollentini, Federico Tocchi, Edward Canepa and Aris Twerda</i>	
Development of an Exhaust Gas Cleaning System for Methanol-Fueled HT-PEM Fuel Cells for Sustainable Maritime Applications	46
<i>Domenico Flagiello, Francesco Di Natale, Clemente Capasso, Filippo Scamardella and Luigia Mocerino</i>	
Experimental Investigation on the Effects of Air-Lubrication in a Stepped Planing Hull	56
<i>Andrea Mancini, Matteo Dell'Abate Di Fabio, Riccardo Scaccia, Fabio Carta, Silvano Grizzi and Massimo Falchi</i>	
Lube Oil Fine Filtration on Board: Protects Environment and Saves Money	69
<i>Elisabetta Piana</i>	

Environmental Product Declaration of Nautical Ropes: A Multi-Impact Category Analysis Through Life Cycle Assessment	77
<i>Anna Laura la Monaca, Alessandro Bordignon, Sabrina Pricl and Andrea Mio</i>	
Analysis of Greenhouse Gas Emissions from Ships Visiting European Ports	85
<i>Petar Georgiev, Yordan Garbatov and Angel Angelov</i>	
Innovative Deck Redesign for Dinghies: Advancing Electric Boat Efficiency and Sustainability	95
<i>Chiara Campese and Giangiacomo Minak</i>	
Eco-Design and Environmental Performance of Smart Buoy for Autonomous Marine Monitoring	102
<i>Fabio Salmeri, Loris Barbieri, Emmanuele Barberi and Filippo Cucinotta</i>	
Meeting Hydrogen Dynamic Demand for on Board Applications Through a Liquid Organic Hydrogen Carrier	112
<i>Pietro Delogu, Mirco Busetto, Davide Bionda, Marco Cosimo Tripoli, Fausto Ferrazzi and Andrea Mio</i>	
Exploring a Hydrogen Solution for a Sustainable Maritime Power System of Yachts	120
<i>Roberta Russo, Tommaso Coppola and Luca Micoli</i>	
Technical Challenges in the Adoption of HVO and FAME as Marine Fuels	128
<i>Luca Micoli, Riccardo Bussi and Angelo Macocco</i>	
Vertical Motion Assessment in the Concept Design Stage of a Small Cruise Ship	138
<i>Samuele Utzeri, Luca Braidotti, Francesco Mauro, Jasna Prpić-Oršić, Serena Bertagna and Vittorio Bucci</i>	
Vibro-Acoustic Simulations for Prediction of Underwater Radiated Noise from Onboard Machinery	148
<i>Andrea Iuliano, Francesca Casuscelli and Emilio De Angelis</i>	
Impact of New Environmental Rules on the Fuel and Emissions Costs of a Mediterranean Cruise	156
<i>Luca Braidotti, Samuele Utzeri, Enrico Del Piero and Alberto Marino</i>	
Hydrogen Powered Ferries in the Adriatic Sea: A Technical and Environmental Assessment	166
<i>Ronelly De Souza, Federico Del Mondo, Elio Padoano, Rodolfo Taccani, Filippo Rezzante and Kristin Zuric</i>	
Shipboard Photovoltaics Integration for Retrofitting Cargo Ships: A Case Study	174
<i>M.C. Di Piazza, M. Pucci, G. Rodono', G. La Tona, O. Yuksel, V. Shagar and A. Iafrati</i>	
Optimized Design of PTO/PTI Systems Driven by Operational Data for Cargo Ship Retrofitting: A Case Study	182
<i>M. Pucci, A. Accetta, M.C. Di Piazza, G. Rodono', O. Yuksel, V. Shagar and A. Iafrati</i>	

Improving Ship Energy Efficiency Through Advanced HVAC Simulation Techniques	190
<i>G. Barone, A. Buonomano, G. Del Papa, C. Forzano, G.F. Giuzio, R. Maka, A. Palombo, G. Russo and S. Zizzania</i>	
Open AIS Data to Assess Seaside Operations in Container Ports	198
<i>Orlando Marco Belcore, Massimo Di Gangi and Antonio Polimeni</i>	
An Integrated Analysis of Innovative Ammonia-Fuelled Technologies for Large Passenger Vessels	208
<i>Simone Piccardo, Massimo Rivarolo, Davide Clematis, Arianna Irace and Daniela Cazzola</i>	
A Structured Framework for Evaluating Logistics Networks: A Multidimensional Approach	216
<i>A. Giallanza and R. Micale</i>	
Use of Biofuels for Reducing OPEX and Air Emissions in the Maritime Sector	224
<i>Rosario Pitruzzo and Francesco Rizzi</i>	
Opportunity for Greener Maritime Transportation	231
<i>Adele Marino and Emilia Vermiglio</i>	
Hydrodynamics	
Analysis of the Virtual Towing Tank Accuracy by Means of a New EFD Database	241
<i>Simone Bozzo, Marco Ferrando and Diego Villa</i>	
Experimental Study of Un-Stationary Tip Vortex Cavitation	252
<i>Giovanni Franzosi, Afaq Ahmed Abbasi, Michele Viviani and Giorgio Tani</i>	
Development of a CFD Based Submarine Manoeuvrability Prediction Code	262
<i>Lorenzo Bertè, Benedetto Piaggio, Luca Scotto, Sebastiano Becchetti, Michele Viviani and Diego Villa</i>	
Development and Application of a Numerical Model for Ship Manoeuvring in Regular and Irregular Waves	273
<i>Maria Acanfora, Silvia Pennino and Antonio Scamardella</i>	
Implementation of Innovative Strategies in Shipbuilding Production: The Experience of SHIPLEARNING on Friction Stir Welding and Reverse Engineering	283
<i>Simone Panfiglio, Elnaeem Abdalla, Chiara Borsellino, Mohamed Chairi, Antonio Denaro, Gabriele Marabello and Guido Di Bella</i>	
Hydrodynamic Analysis of a Stepped Planing Hull Through Sea Trials and CFD Simulations	293
<i>Massimiliano Chillemi, Filippo Cucinotta and Felice Sfravara</i>	
A B-Spline Rankine Panel Method for the Double-Body Flow Problem Solution for Time Domain Seakeeping Applications	303
<i>Francesco Soardi and Giuliano Vernengo</i>	

A Numerical Overview of the Influence of Cavitation on Cycloidal Propeller Performances	313
<i>Nicolas Guano, Silvia Donnarumma and Stefano Gaggero</i>	
Drag Reduction Devices for Marine Applications	323
<i>Benedetto Mele</i>	
Deriving of a Numerical Propulsion and Steering Model for a Cycloidal Propeller	331
<i>Tomasz Gornicz, Victor Ferrari, Daniele Milazzo, Anna Maslowska and Artur K. Lidtke</i>	
Supersilent Propellers for New Generation Cruise Vessels	342
<i>Gianpiero Lavini, Gianluca Gustin, Alessandro Marino and Edoardo Tagliamonte</i>	
A Comprehensive Study on the Influence of Scale and Draft Variations on Form Factor Using a Combined EFD/CFD Approach	352
<i>Minas Argyros, Simone Mancini, Kadir Burak Korkmaz and Arash Eslamdoost</i>	
Comparison of Regression Models for Hydrodynamic Hull Forces	367
<i>Victor Ferrari, Anna Maslowska and Tomasz Gornicz</i>	
Scale Effect Assessment on Trim Optimization Study	378
<i>Maria De Carlini, Simone Mancini, Vincenzo Sorrentino, Marco Altosole, Andrea D'Ambra and Dario Bocchetti</i>	
Bridging the Skills Gap in Maritime Training: Preparing the Workforce for Vessel Electrification	388
<i>Daniele Palma Esposito, Vittorio Sangermano, Ahmet Aksozand, Mustafa Şeker, Ioannis Ergas, Álvaro Reina Illanes, Alan Younger, Mehdi Zadeh and Dong Trong Nguyen</i>	
High-Speed Craft with Double Interceptor System in Calm Water: URANS Solution	396
<i>Fatemeh Roshan, Abbas Dashtimanesh, Fabio De Luca and Simone Mancini</i>	
Performance Prediction of Planing Catamarans Using Mathematical and CFD Models	408
<i>Rasul Niazmand Bilandi, Abbas Dashtimanesh, Sasan Tavakoli and Simone Mancini</i>	
Marine Renewable Energy and Resources	
A Critical Review of Gyroscopic Wave Energy Conversion Systems	419
<i>Gabriele Bocchetta, Antonio C. Caputo and Claudio Lugni</i>	
Effects of Heaving Plate on the Dynamics of a Novel Floater Concept for FOWT	429
<i>Luis D. Luna A., Edoardo Bruni, Claudia Chianese, Gianni Scherl, Diego Vicinanza and Claudio Lugni</i>	

Digital Modelling of Cavitation Risk in Tidal Stream Turbines <i>Luigi Dodaro, Francesco Salvatore, Fabio Di Felice, Nicho Kaufmann and Ralf Starzmann</i>	439
Modeling Adaptive Technologies and Clean Fuels Towards Climate-Neutral Shipping <i>Phoebe Koundouri, Angelos Alamanos, Christopher Deranian, Olympia Nisiforou and Jorge Andres Garcia</i>	449
Advancing Marine Renewable Energy in the Mediterranean Sea: Devices Development and De-Risking Strategies at MaRELab <i>Sara Russo, Andrea Bardazzi, Alessia Lucarelli, Chiara Pilloton, Marilena Greco, Arianna Azzellino, Pasquale Contestabile, Diego Vicinanza and Claudio Lugni</i>	459
Hydrodynamic Analysis of a Floating Solar Island <i>Camilla Luvisetto, Alessia Lucarelli, Francesco Piccione, Francesco Saverio Di Tomaso and Claudio Lugni</i>	466
Naval Ships and Submarines	
Battery Energy Storage Systems for Emission Reduction: A Roadmap for Strategic Loading of Naval Ships <i>Daniele Belvisi and Massimo Figari</i>	476
Concept Design and Subsystems Integration of a Multi Capability Drone Carrier Warship <i>Daniele Bet, Gianluca Maria Marcelli, Lino Magnoni and Amanda Candido</i>	486
Preliminary Analysis on the Integration of Directed Energy Systems in the Next Generation Surface Naval Vessels <i>Michele Giannella, Paolo Borghese, Andrea Vicenzutti, Andrea Alessia Tavagnutti and Giorgio Sulligoi</i>	495
Risk Factors Preventing Ships from Effective Vessel Traffic Services Reporting <i>Selahattin Alan and Elif Bal Beşikçi</i>	503
Preliminary Design of a Full-Lithium-Ion Battery Conventional Submarine <i>Alessandro Fina and Stefano De Cicco</i>	508
Design Analysis of the Ancient Italian Frigate “Terribile” <i>Ernesto Fasano and Gennaro Rosano</i>	517
Offshore and Underwater Technologies	
An Investment Cost Estimation Model for Gyroscopic Wave Energy Conversion Systems <i>Gabriele Bocchetta and Antonio C. Caputo</i>	528
Evaluation of the Effectiveness of Using Buckle Arrestors to Prevent Subsea Pipeline Propagation Buckling in West Africa Fields <i>Sampson Kennie Wayoe</i>	538

Advantages and Disadvantages of Different Solvers for Preliminary DP Capability and Operability Predictions <i>Francesco Mauro and Gennaro Rosano</i>	547
Towards Optimized Maritime Energy: Focus on an Energy Analysis and Management to Replace Conventional Power Systems with Hydrogen Solutions <i>Stefano Malabotti, Tancredi Chinese, Michela Zanelli, Alessio Carroni, Michele Capobianco, Nicola Zuliani, Davide Pivetta, Marco Bogar, Rodolfo Taccani, Irene Lavagnini and Filippo Rezzante</i>	559
A Modular Approach for Defining the Technical Characteristics of Offshore Support Vessels from a Safety Perspective <i>Panagiotis Sotiralis, Angeliki Stouraiti, Manolis Annetis and Nikolaos P. Ventikos</i>	567
Experimental Proof-of-Concept of Passive Bio-Inspired Sensing Strategy for Autonomous Underwater Vehicles <i>Casper Potter, Marilena Greco, Romain Garat and Claudio Lugni</i>	576
Safety and Security	
Safe Return to Port 2010–2025, the Revolution in Passenger Ship Design <i>Alessandro Maccari</i>	585
Advancing Safety and Sustainability in LNG-Powered Vessels: Insights from Romania’s First LNG Bunkering and Commissioning <i>Florin Barbu, Eugen-Victor-Cristian Rusu, Liviu-Constantin Stan and Costel Ungureanu</i>	598
A Prototypal Dynamic GNSS Integrity Framework for Coastal Navigation in WebGIS <i>Marcello La Guardia, Giuseppe Mussumeci and Antonio Angrisano</i>	606
The Evolution of Technical and Operational Aspects of the Greek Owned Tugboats Fleet <i>Alexandros Koimtoglou, Panagiotis Sotiralis, Konstantinos Louzis and Nikolaos P. Ventikos</i>	614
Design Safety Assessment for Liquid Hydrogen Systems on Board Cruise Ships Through a Risk Based Approach <i>Irene Lavagnini, Filippo Rezzante, Pierluigi Busetto, Fabrizio Cadenaro, Matteo Roiaz, Gabriele Sancin and Elia Russian</i>	623
Quantitative Risk Assessment: Frequency Analysis of a Liquid Hydrogen Tank Container Swap Operation on a Passenger Ship <i>Elia Russian, Irene Lavagnini, Filippo Rezzante and Rodolfo Taccani</i>	632

Ship Design

Preliminary Design of a Dual Propulsive/Regenerative Device for Sail Ships: SAIL-POD by Velettrica <i>Roberto Baffigo, Alessandro Lidozzi, Marco di Benedetto, Danilo Calcagni and Andrea Mancini</i>	643
An Overview of the Shipbuilding Labour Market: The LeaderSHIP EU Project <i>T. Pais, G. Vergassola, M. Gaiotti, C.M. Rizzo, J. Valtanen, S. Kivela, W. Lenarduzzi, M. Hauninen, A.H. Laot, P.P. Gilles, M. El Faziki, M. Nechita, G. Popescu, J. Thormodsæter, K. Severeide, A. Mendibil, F. Miguelez, J.A. Campos, J. Sanchez-Beaskoetxea, D. Boullosa-Falces and A. Rossi</i>	655
The CFD Potentiality on the AUV Hydrodynamic Design <i>Diego Villa and Stefano Gaggero</i>	663
A Stability in Waves Assessment of Self-Righting Vessels <i>Nicola Petacco, Valerio Ruggiero and Paola Gualeni</i>	674
Experimental Investigation of Free Surface Effects on Propulsion Performance of a Propeller Operating near the Free Surface <i>Jeongsoo Ha and Shin Hyung Rhee</i>	684
Full-Scale RANS Validation of Multi-Fidelity Bow Optimization for a RoRo Cargo Ship <i>A. Del Buono, R. Broglia, A. Serani, M. Diez, A. Maione and C. Cervicato</i>	688
Poseidon: A Modular and Sustainable Approach to Maritime Passenger Transport <i>Angela Denise Peri and Massimo Musio-Sale</i>	697
Luxury Cruise Ship Design: Evolution and New Perspectives <i>Mario Ivan Zignego, Davide Nicolini and Elisabetta Proia</i>	707
Luxury Cruise Ship Design – Integration of Smart Materials and Adaptive Technologies in Modular Cabins <i>Angela Denise Peri and Massimo Musio-Sale</i>	723
Luxury Cruise Ship Design – A Systemic Approach Towards Energy Efficiency <i>Massimiliano Cavallin and Lei Gao</i>	734
Uncertainties in the Evaluation of the Structural Capacity of the Hull Girder <i>Tomaso Gaggero and Enrico Rizzuto</i>	745
Surrogate Models for Propulsive Performance in the Feasibility Study of Cruise Ships <i>Antonio Brunello, Francesco Mauro, Luca Braidotti and Vittorio Bucci</i>	754
NAV 2025: The ETAProp Concept, a New Solution That Optimizes the Relationships Between Hull-Propeller and Rudder <i>Claudio Buccini and Giovanni Caprino</i>	768

Ship Digitalization and Autonomous Vehicles

- Adaptive Rendezvous Planning Algorithm for Energy-Efficient Marine Operations 775
Maicol Laurenza, Gianluca Pepe, Herbert Martins Gomes and Walter Jesus Paucar Casas
- A Discussion About the Ship Digital Platform as a Step Forward for Digital Transformation in the Maritime Domain 783
Goran Petkovic, Nicola Petacco, Aldo Zini and Paola Gualeni
- Digital Technologies Can Modify the Decision-Making Process on Ship Bridges 793
Michele Martelli, Giacomo Longo, Enrico Russo and Raphael Zaccone
- Coordinated Swarm Operations of Unmanned Surface Vehicles for Coastal Surveillance and Search and Rescue Missions 802
Egidio D'Amato and Silvia Pennino
- Far-Field Wake Modeling for Automatic Ship Detection from Satellite Imagery 810
Nicola Petacco, Diego Villa, Federico Franciosa, Andrea Mazzeo, Angela Carmen Cristofano, Fabio Rossini, Maria Daniela Graziano, Marco Scarpa, Federica Braga, Paolo Vavasori, Davide Bonaldo and Giuliano Vernengo
- A Roadmap for the Safe Implementation of MASS: Aligning International Standards and Flag State Approvals 818
Pietro Corsi, Sergej Jakovlev and Edvinas Pocevicus

Ship Propulsion, Machinery and Systems

- Numerical Simulations of a Bulk Carrier with Flettner Rotors Using a Fully Nonlinear Potential Flow Solver 827
Manuel Coppola, Francesco Coslovich and Mitja Morgut
- Application of Modern Optimisation Techniques for Sustainable Ship Designs: A Case Study from Venice 835
Giancarlo Marelli, Antonino Dell'Acqua, Gianluca Giurco and Germano Degan
- Advancing Maritime Training Through a VR-Enhanced Ship Bridge Simulator: A Preliminary Usability Analysis 846
Virginia D'Augusta, Lucia Gazzaneo, Francesco Longo, Karen Althea Manfredi, Letizia Nicoletti, Antonio Padovano, Vittorio Solina and Simone Talarico
- Methanol on Board: Technical Challenges and Regulatory Compliance 856
Matteo Roiaz, Ilir Batalli, Maurizio Crucil, Fabrizio Cadenaro, Marco Nardo, Adriana Crosato, Emilio Agnello and Gabriele Sancin
- Optimized Energy Storage System Sizing for a Series Hybrid Waterbus to Minimize Pollutant Emissions 864
Federico Miretti, Francesco Novello, Daniela Anna Misul, Giulio Gennaro and Antonio Ferrari

Ship Structures and Materials

From International Standards to Classification Rules: Application on Board Ships of Adhesive Non-Structural Fasteners <i>Giovanni Rognoni, Giada Kyaw Oo D'Amore, Emanuele Brocco, Luciano Stefanutti and Marco Biot</i>	873
Stress Concentration in Marine Crossing Cutouts via IsoGeometric Analysis <i>Claudia Chianese, Maria Acanfora and Marco Altosole</i>	881
Sea Spectra Estimation from Hull Motions: Experimental Assessment of Regular and Irregular Sea Response Amplitude Operators <i>Maria Acanfora, Marco Altosole, Flavio Balsamo, Fabio De Luca, Simone Mancini and Riccardo Pigazzini</i>	889
Effect of Sea State Conditions on Small Vessels <i>Claudio Alacqua, Davide Crisafulli, Giulia Palomba, Davide Blandina and Pasqualino Corigliano</i>	898
Adopting Additive Manufacturing in Shipbuilding: Managing the Transition to Innovative Design, Structures and Materials <i>Mohamed Chairi, Gabriele Marabello, Pasqualino Corigliano, Giulia Palomba and Guido Di Bella</i>	909
Modal Analysis of a Catamaran Cockpit: Numerical Models, Experimental Tests and Sea Trials <i>Giovanni Briguglio, Vincenzo Crupi, Fabio Distefano, Fabrizio Freni and Roberto Montanini</i>	921
Fatigue Life Prediction of Ship Structures Under Varying Sea States Using Numerical Simulations <i>Davide Crisafulli, Marco Quattrone, Giulia Palomba and Pasqualino Corigliano</i>	929
Incidence of Rank Correlation Algorithm on the Assessment of Bimodal Sea State Conditions Based on Ship Motion Analysis <i>Vincenzo Piscopo and Antonio Scamardella</i>	940
Innovative Design and Fabrication Environment for Robotic Additive Manufacturing of Sustainable Sandwich Structures <i>Simone Scattareggia Marchese, Paolo Giorgianni, Yordan Garbatov, Vincenzo Crupi, Gabriella Epasto and Sandro Scattareggia Marchese</i>	948
Numerical Evaluation of Ships Collisions <i>Marcello Raffaele, Giulia Palomba, Felice Sfravara and Pasqualino Corigliano</i>	958
Efficient Integration of Machine Learning and Optimization Techniques into Passenger Ships Structural Design <i>Ciro Busiello, Mauro Sicchiero, Matteo Sidari, Lorenzo Fabris and Gianluigi Rozza</i>	969

Optimisation of a Hybrid-Parallel Power Train for a Aframax Tanker to Minimise Emissions in Every Operative Condition	980
<i>Samuele Utzeri, Luca Braidotti, Serena Bertagna, Donato Padolecchia, Natasha Taucer Marchesi, Enrico Del Piero, Vittorio Bucci and Alberto Marino</i>	
Comparative Numerical Study on the Crashworthiness of Ship Structures	990
<i>Giulia Palomba, Vincenzo Crupi and Pasqualino Corigliano</i>	
Investigation on the Tensile Properties of Virgin and Recycled HDPE for Boatbuilding Applications Through Experimental Tests	999
<i>Serena Bertagna, Natasha Taucer Marchesi, Vittorio Bucci, Giuseppe Brando, Fabio Distefano, Vincenzo Crupi and Alberto Marino</i>	
Experimental Techniques for the Assessment of the Mechanical Behaviour of HDPE Used in Boat Building	1009
<i>Giuseppe Brando, Serena Bertagna, Vincenzo Crupi, Fabio Distefano, Gabriella Epasto and Alberto Marino</i>	
Parametric Design of HDPE Testing Specimens for Boatbuilding Applications	1018
<i>Natasha Taucer Marchesi, Serena Bertagna, Donato Padolecchia, Vittorio Bucci and Alberto Marino</i>	
3D Parametric Modeling for Ship Concept Design: A Flexible Approach to General Arrangement Plan	1028
<i>Donato Padolecchia, Natasha Taucer Marchesi, Serena Bertagna and Vittorio Bucci</i>	
Three-Point Bending Test for Mechanical Characterization of Commercial Antifouling Coating Deposited on DH36 Steel Plate	1038
<i>Gabriella Epasto, Fabio Giudice, Daniele Rizzo, Cristina Scolaro, Andrea Mariano Sili and Annamaria Visco</i>	
A Comparative Life Cycle Assessment of Structural Solutions Using Dissimilar Materials and Hybrid Joints	1046
<i>Francesca Di Carolo, Pratap Kumar John, Rosa De Finis, Davide Palumbo, Ester D'Accardi, Vincenzo Crupi, Giovanni Briguglio and Umberto Galietti</i>	
Characterization of Hybrid-Dissimilar Joints Using Non-Destructive Thermographic Techniques	1056
<i>Francesca Di Carolo, Rosa De Finis, Davide Palumbo, Ester D'Accardi, Gabriella Epasto and Umberto Galietti</i>	
Dissimilar Welded Joints for Ship Structures	1066
<i>Vincenzo Crupi, Gabriella Epasto, Fabio Distefano, Giuseppe Brando, Francesca Di Carolo, Ester D'Accardi and Umberto Galietti</i>	
Hybrid-Dissimilar Joints for Lightweight Structures	1075
<i>Gabriella Epasto, Celestino Giorgianni, Ester D'Accardi, Francesca Di Carolo and Daniele Rizzo</i>	

Yacht Design

- The Integration of AI Technologies in Modern Yacht Design Methodology 1082
*Laura Pagani, Paolo Gemelli, Mario Ivan Zignego
 and Alessandro Bertirotti*
- Communication and Yacht Design: Strategies for Sustainable Luxury 1090
Daniela Noel
- Interior Yacht Design for People with Autism Spectrum Disorder (ASD) 1097
Massimiliano Di Lecce
- Offshore Powerboating Safety&Composite Material: Evolution of UIM
 Sporting Regulations and the Use of Composite Materials 1105
Sergio Abrami Y.D.
- Analysis of Beam-to-Length Ratio Trends in Superyachts: Implications for
 Design, Performance and Regulatory Compliance 1116
Angela Denise Peri and Valerio Ruggiero

Workshop

- Smart Robotics in Shipbuilding Process 1127
Dentesano Carlo
- Fincantieri Shipyards Digital Twin Model 1137
Tharsis Pilutti Namer and Michele Tornielli
- A Modular Control Room for Smart Port as Event-Driven DSS 1146
Francesco Acanfora, Daniele Frisoni and Francesca Sparaci
- Maritime Cyber Security Platform (MCSP) 1154
*Giuseppe Laurenza, Roberto Tacconi, Marco Dri, Stefano Landucci
 and Daniele Ali*
- Digital Twin Approach for Ship Energy Management 1164
A. Bonvicini, D. Cangelosi, R. Ingargiola, A. Marchese and G. Previti
- The Fincantieri Digital Ecosystem: A Comprehensive Approach to Ship
 Digitalization 1172
Samuele Callegari and Silvio Iannace
- Author Index 1180

Luxury Cruise Ship Design: Evolution and New Perspectives

Mario Ivan ZIGNEGO^{a,1}, Davide NICOLINI^b, Elisabetta PROIA^c

^{a,1} Full Professor. Department of Architecture and Design (DAD), University of Genoa

^b PhD Student. Department of Architecture and Design (DAD), University of Genoa

^c PhD Student. Department of Architecture and Design (DAD), University of Genoa

ORCID ID: Mario Ivan ZIGNEGO <https://orcid.org/0000-0003-2448-2262>

Davide NICOLINI <https://orcid.org/0009-0000-8594-7161>

Elisabetta PROIA <https://orcid.org/0009-0006-3146-4707>

Abstract. The luxury cruise industry has experienced significant changes driven by evolving social and cultural expectations of guests. This aspect has driven a rethinking of onboard experiences, leading to a redefinition of onboard urban planning and a comprehensive redefinition of decks functional layout. In this context, cruise ships are now expected to blend the best aspects of hospitality, technology and luxury living. This research aims to enhance passenger comfort and satisfaction by designing small vessels (100-150 meters) with a maximum capacity of 100 guests and a crew-to-passenger ratio of 1:1. Streamlined vertical connections and a well-organized distribution of technical and service spaces provide an even more efficient separation of crew and guest areas. The design convergence brings luxury ships close to mega yachts, with greater attention to privacy, accessibility and relative arrangement of common and private areas. Inspired by the luxury hospitality sector and fine dining, interiors spaces have been reshaped to provide high-quality, tailored experiences. The analysis includes a diachronic study of past cruise ships to illustrate design evolution and the changing passenger demographics over time. It explores how these transformations have affected management practices and redefined the travel experience, with a focus on the relationship between onboard layout, new itinerary strategies and event organization. The assessment of specific case studies highlights the practical implications of design choices and provides guidelines for optimizing the distribution and operational arrangements in future generations of luxury cruise ships.

Keywords. Luxury Cruise Ships, Cruise Ships, Interior Design, Space Optimisation, 1:1 crew-to-passenger ratio, Hospitality

1. Introduction

A significant and symbolic experience in 20th-century navigation is the story of ocean liners. First steamships and then ocean liners were designed to transport passengers across the Atlantic to the Americas. These vessels can be seen as fascinating phenomena within the realm of ships, representing a significant turning point in seafaring and symbols of luxury and prestige. From an engineering perspective, there is a transition from ships that could disappear without ever reaching the Americas to high-performance,

¹ Corresponding Author: Mario Ivan ZIGNEGO, mario.ivan.zignego@unige.it

cutting-edge vessels capable of achieving remarkable stability and impressive cruising speeds.

Architecturally, there is a shift from imitating the grand palaces and luxury hotels on the mainland. This trend incorporates decorative styles influenced by significant European interior design periods, including Hispano-Moorish, Florentine Quattrocento, from Pompeian to the 18th-century Baroque. This initial phase can be viewed as a rejection of the ship's geometry, transferring static terrestrial architecture into a marine design intended for movement. The Coppedè brothers and the Ducrot company of Palermo exemplify this style.

On the other hand, architect Gustavo Finali Pulitzer from Trieste and his studio Stuard offered a distinct perspective. Pulitzer is celebrated for his design philosophy which respects the connections among a ship's physical space, engineering components and intended function. He acknowledged the significance of bespoke designs for ocean liners and was a forerunner in merging art with maritime architecture. His approach was acknowledged and subsequently adopted by Milanese architect Gio Ponti, who lauded Pulitzer's work in the magazine *Domus* [1].

Gio Ponti's work on the ocean liner *Andrea Doria* embodies Pulitzer's philosophy. He not only honours the ship's curved geometry defined by its proportions but also enhances it through artistic expression. The wall becomes a piece of art, featuring a painting applied directly to its surface.



Figure 1. Transatlantic *Andrea Doria* (1951). Creative Commons License

Another perspective on the evolution of seafaring involves analysing the objectives behind the voyages. The ocean liner emerged from a genuine need: migration. Economic and social circumstances drove people to seek wealth in the New World. These journeys were primarily motivated by necessity, leaving little room for architectural or aesthetic considerations. It was only later that these voyages transformed from a necessity into a leisure activity. First-class travellers, part of the wealthy elite, shifted their focus from seeking fortune to enjoying trips to the Americas for pure pleasure. The ship became a crucial element of the journey, functioning not only as a means of transport but also as a sophisticated and elegant space for first-class passengers.

By the late 1950s, cruise ships began to replace ocean liners. This change was largely driven by the rise of air travel, enabling people to reach the Americas in considerably

less time. Cruise ships were designed to provide a completely different travel experience—a blend of entertainment, luxury, and comfort that offered passengers a unique holiday at sea. The shift from ocean liners to cruise ships represented a fundamental change in naval design and planning, prioritising passengers' experience and comfort in every aspect of the design process [2].

2. Methodology and Research Approach

This research employs a multidisciplinary framework to explore the progression of luxury cruise ship design, integrating architectural analysis, hospitality principles, and operational strategies. It is based on a diachronic examination of cruise vessels—from early ocean liners to modern ultra-luxury ships, highlighting significant shifts in spatial organisation and guest experience.

The methodology involves a comparative analysis of selected case studies, both historical and modern, to assess design evolution and strategic patterns. These cases were chosen for their significance in innovation, market positioning and impact on the cruise sector. The study analyses technical factors like spatial ratios, service flow layouts and material use, alongside demographic changes and evolving experiential expectations.

This layered analysis seeks to establish design guidelines for future luxury cruise ships, focusing on comfort, privacy, and personalization. Combining qualitative and quantitative data offers a thorough understanding of the intersection between architecture and experience at sea.

The interior design considerations presented in this study, particularly regarding spatial standards, circulation logic, and service organisation, are the result of original research conducted by the team based on comparative analysis and operational criteria.

3. From Mass-Market Cruise Ships To Luxury Cruise Liners

Mass-market cruise ships are notable for their large size, designed to host thousands of passengers, typically ranging from 2,000 to 6,000. These cruises often focus on shorter trips to popular destinations like the Mediterranean, Caribbean, and Northern Europe. Guests enjoy various onboard services, including entertainment, dining and swimming pools. Cabin options vary from basic and budget-friendly interior cabins to more spacious and luxurious choices, complete with balconies and ocean views, catering to the diverse preferences of a wide range of travellers.

Mass-market cruise ships have transformed the concept of seaborne holidays. Companies such as Carnival, Norwegian Cruise Line, and Royal Caribbean have made this travel experience more accessible to a broader segment of the global population by offering all-inclusive packages.

However, an increasing number of passengers began to seek more refined and custom-tailored travel experiences. These changing expectations presented valuable design opportunities, providing architects and designers new parameters and inspirations. From this demand for more exclusive cruises, the luxury cruise sector emerged. This niche began to take shape in the 1990s and has continued to grow through the early decades of the 21st century [3].

Luxury cruise ships distinguish themselves from their mass-market counterparts primarily in vessel size and passenger capacity. In the most exclusive segment, maximum capacity typically ranges from 600 to 700 guests, for whom service is tailored to meet individual needs and preferences. Notable luxury cruise lines include Seabourn, Silversea, and Regent Seven Seas Cruises.



Figure 2. Wonder Of The Seas Cruise Ship, Royal Caribbean (2020). Creative Commons License

4. From Luxury Cruise Ships To Ultra-Luxury Cruise Ships

Since the 2000s, the final evolution of this trend has resulted in the emergence of ultra-luxury cruise ships, boasting a crew-to-passenger ratio of 1:1. The service provided on board these vessels is so tailored that each guest has a dedicated crew member at their disposal. In contrast, traditional cruise ships typically have a crew-to-passenger ratio ranging from 1:3 to 1:5. This ratio on ultra-luxury ships enables a customised experience for guests.

The ships within this market segment have a maximum capacity of 100 to 150 passengers. The targeted customer for this market comprises highly affluent individuals, entrepreneurs, professionals, celebrities and aristocrats, who seek not just a trip, but a unique and unparalleled experience. Requests from this clientele include highly personal services with custom activities, such as private excursions and in-suite dining. Privacy and discretion are crucial elements. The cabins guarantee maximum confidentiality and discretion, while the common areas are minimised to create exclusive spaces catering to every need.



Figure 3. Le Bouganville Cruise Ship (2019), Ponant. Creative Commons License

Modern cruise ships have evolved into outstanding examples of engineering and design over the years, drawing inspiration from mega yachts and luxury hotels, while also responding to new social and cultural expectations. Consequently, the cruise industry has frequently intersected with and drawn influence from the yacht market. This trend originated with the rise of the private mega yacht sector during the 1980s and 1990s, when very wealthy individuals began to prefer exclusive, tailor-made trips.

The evolution of yacht-style luxury cruise ships marked a significant change in the cruise industry, blending private yachting experience with traditional cruising. As a result, companies began designing vessels that accommodate fewer passengers, achieving a 1:1 ratio of guests to crew members. This trend signifies a shift in travel perception, viewing the journey as a unique event that emphasises personalization and exclusivity, aligning with the guest's social status. In this context, ultra-luxury cruises represent more than just leisure; they provide an experience that fully immerses travellers in luxury and social distinction [4].

An important factor is the advancement of maritime technologies and the emphasis on sustainability, which have reduced operating costs and the construction of smaller yet more efficient ships regarding the services offered to the guests.

5. Post-Pandemic Evolution Of The Luxury Cruise Sector

In recent years, the luxury cruise sector has grown significantly, greatly impacting the maritime industry and ship design. This change has primarily resulted from shifts in consumer preferences following the pandemic. A growing number of individuals are choosing remote and exclusive destinations over large crowds, a demand that Small Luxury Cruises successfully meets by providing comfort, privacy, luxury, and access to areas unreachable by larger ships.

Luxury cruises strive to deliver an experience that overcomes basic expectations, emphasising quality, exclusivity and heightened status. Although the luxury cruise model resembles that of mega yachts, it also complies with SOLAS maritime regulations

regarding ship safety. Luxury hospitality heavily influences these vessels, drawing inspiration from renowned brands such as Fairmont Hotels & Resorts, Hilton Hotels & Resorts, Mandarin Oriental, and Four Seasons. The luxury yacht industry has more than doubled in size over the past decade [5].

Demand notably increased after the COVID-19 pandemic disrupted global tourism in March 2020, leading to a rise in advertisements for upscale yacht vacations and small luxury cruises [6]. This trend highlights their growing appeal as an alternative to traditional mass-market cruises, which host large numbers of guests on one ship. The mega yacht and luxury cruise markets are closely intertwined.

5.1 Market Size and Global Trends

The luxury cruise industry represents a significant sector, generating \$ 154 billion in 2019, prior to the COVID-19 pandemic (CLIA, 2021). By 2021, revenues from luxury cruises came from 323 active small cruise ships worldwide, owned by over 70 ocean and river cruise companies (2021 data, Cruise Market Watch). In 2020, the luxury nautical sector was valued at \$64.1 billion [7] with forecasts predicting it will exceed \$83.2 billion by the end of 2025, bolstered by an annual growth rate of 4.1% from 2020 to 2027 [7].

At the beginning of the last decade, Europe was the preferred luxury travel destination, with 41% of participants selecting the continent, particularly noting France (14%) and Italy (9%). However, today luxury cruise routes have greatly diversified, with emerging locations such as the Americas, the Arab world, and Asia gaining traction, offering a broader spectrum of distinctive global experiences.

In 2018, a Chinese government report titled "Some Opinions and Suggestions on Promoting the Development of the Cruise Industry in China" acknowledged the immense potential of the Chinese cruise tourism market. The government aims to establish one of the world's most vibrant cruise markets by 2035, underscoring its commitment to develop further the cruise sector in China, which is increasingly recognised as a significant player in luxury cruise destinations.

The Luxury Cruise sector features ships that differ greatly in size and capacity. For example, the Crystal Esprit measures 82 meters in length, has a gross tonnage of 3,300 GT, and accommodates up to 62 passengers[8]. In contrast, Windstar vessels typically carry between 250 and 350 guests and boast a gross tonnage of around 10,000 tons[9]. Another key operator, Seabourn, usually hosts 450 passengers, measures 198 meters long, and weighs 32,346 GT [10].

Notable brands in the small luxury cruise market include Oceania Cruises, Emerald Cruises, Silversea Cruises, Ponant, and Scenic Eclipse, each with a unique focus. Global tourism experienced severe disruptions due to the COVID-19 pandemic, exacerbated by media reports that inflated contagion risks on cruise ships, which heightened traveller anxiety. As the health crisis unfolded, cruise ships came under extensive scrutiny, significantly impeding the industry's recovery. This situation led to a surge in demand for luxury experiences aboard yachts and smaller vessels, which offered a more exclusive and secure environment, fulfilling travellers' desires for serenity and control during their journeys. While luxury mega yachts are generally more compact, some can surpass the size of specific luxury cruise ships.

Luxury cruises typically maintain a guest-to-crew ratio of 1:1[11], whereas certain luxury yachts achieve a 1:2 ratio and can even drop to 1:0.5, ensuring highly personalised service. Although larger luxury cruise ships tend to be more economical, their interior

design combines elegance with durability, allowing them to withstand extensive use by numerous passengers while providing comfort and longevity.



Figure 4. Symbiosis (AY 2024-25) – Riccardo Etai, Gianluca Ferrante, Niccolò Marini, Paolo Spanu, Daniele Versace, Luca Gagliano.

5.2 Demographics and Traveller Preferences

Recognising the target audience in the luxury cruise market has proven more complex than anticipated. Traditionally, cruise lines attracted primarily older demographics, but this is changing rapidly. Nowadays, various companies provide customised experiences for distinct demographic groups, categorising their offerings by age. Insights from Karen Warrel and Tatiana Gladkikh, as detailed in *Luxury Yachting versus Luxury Cruising: Differences, Similarities, and Customer Choices*, suggest that older travellers, particularly those over 65, often prefer brands like Cunard and Silversea. Conversely, couples aged 40 to 65 typically choose lines such as Seabourn, Regent Seven Seas, and Viking. Nonetheless, a significant transformation is occurring: luxury travellers are becoming increasingly younger. As Baby Boomers hand over to Generation X, individuals in their forties are gaining the purchasing power previously held by those in their fifties. Indeed, a notable segment of affluent luxury travellers is now in their thirties and forties [12].

Although this trend may vary by country, the general pattern shows that luxury cruise travellers can no longer be limited to a specific age group or nationality. The one universal trait among luxury travellers is their financial capability, which allows them to engage in these premium experiences.

While the previous sections focused on market trends and user profiles based on external sources and industry reports, the following part of the study presents original design reflections developed by the research team. These include considerations related to interior layouts, functional zoning, and space planning for small luxury cruise ships.

Although some ultra-luxury cruise ships in the current market offer a 1:1 crew-to-passenger ratio, they typically accommodate between 500 and 700 guests. This research instead focuses on a different scale: small vessels hosting a maximum of 100 passengers. In this context, the 1:1 ratio is not simply a service metric but a structural design principle that informs spatial organisation, circulation flows, and the overall onboard experience.

6. Design and Interior Layouts

Luxury cruise ships offer numerous opportunities for onboard exclusivity, primarily in three main areas that constitute over 60% of guest space: cabins, dining areas, and lounges.

The cabins vary in size depending on their type, primarily featuring suites with stunning sea views. A notable recent addition is the Emerald Sakara from Emerald Cruise, launched in 2023. Its cabins are classified as follows: Owner's Suite: 109-111 m², Yacht Suite: 65-67 m², Deluxe Balcony Suite: 36-38 m², Balcony Suite: 27-29 m², Terrace Suite: 60-62 m², and Oceanview Stateroom: 17-20 m². Additionally, certain ships from Oceania Cruise and Regent Seven Seas offer suites exceeding 1,000 m², delivering an exceptionally exclusive luxury experience.

According to the Neufert design standards, the kitchen must cover at least 20 m² to serve up to 50 covers, including the washing area. The space should increase by 0.5 m² for each extra cover to accommodate additional meals. If the number of covers is over 100, a separate dishwashing area will be required, although smaller kitchens may have exceptions based on structural, equipment, and operational needs. For example, pizzerias require a minimum of 12 m², excluding the space for the oven.

On luxury cruise ships, inspired by high hotel standards, kitchen space is designed to allocate from 7 to 12 m² for every 10 passengers. This ratio varies due to multiple factors: the luxury level (fine dining demands more space for food preparation and presentation), the number of dining venues that rely on the central kitchen, and the complexity of the menu (more complex dishes necessitate additional workstations and equipment). Typically, for 100 passengers, the kitchen on luxury ships should range from 70 m² to 120 m², as they are designed to serve guests over multiple shifts (breakfast, lunch, dinner), thereby distributing the workload efficiently.

However, the available space must still guarantee high-quality service and elegant plating. Specifically:

- Food storage space: approximately 20-25% of the kitchen area;
- Equipment and cleaning: 15-20% of the kitchen area;
- Active preparation and cooking zones: 50-60% of the kitchen area.

When calculating the overall size of restaurant areas, several sections are taken into account:

- Dining area (Front of House): includes seating, aisles, and furnishings;
- Kitchen (Back of House): encompasses cooking, preparation, cleaning, and storage areas;

- Support areas: consist of restrooms, staff relaxation rooms, office spaces, and service areas.

In fine dining, the recommended space per customer is 1.8-2.7 m² per seat. Thus, for a dining capacity of 100 people, the restaurant area should span approximately 200-300 m². On luxury cruise ships, lounge areas typically provide 1.5-2.5 m² per passenger, varying by type.

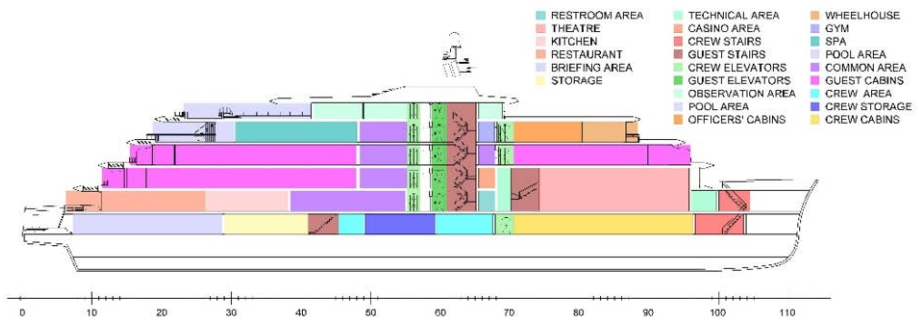


Figure 5. Rimor: hypothesis of internal subdivisions (AY 2024-25): Marco Claudio Cavallo, Adriano Publio Elio Panizzi, Elio Tublio, Edoardo Tommasi, Leonardo Camatta, Agnese Fanti, Nicola La Commare.

6.1 Operational Management and Service Logistics

The layout and design of small luxury cruise ships directly impact onboard operational efficiency. In vessels with a 1:1 crew-to-passenger ratio, service flows must be optimised to maintain discretion while delivering premium hospitality. The spatial organisation must, therefore, facilitate smooth logistical operations without compromising the guest experience.

Crew movement is managed through separate corridors, stairways, and technical shafts, allowing for behind-the-scenes operations such as housekeeping, catering, and maintenance. Service elevators are located away from guest routes to ensure uninterrupted workflows and reduce visible staff presence in public areas. Galley and pantry positioning is also critical: they are often placed centrally relative to dining venues to minimise travel distance and maintain food quality and timing.

Small luxury vessels require highly tailored workflows compared to larger cruise ships, where standardised processes serve thousands of guests. This includes personalised in-suite services, just-in-time restocking of amenities and flexible scheduling for dining and wellness experiences. Staff must operate efficiently across multiple functions while maintaining the tailor-made approach expected by high-end travellers.

The overall spatial configuration thus supports a hotel-like operational logic, where back-of-house and front-of-house functions are distinctly planned. The close coordination between architectural design and service management systems ensures that luxury standards are consistently met without visible strain on operations.

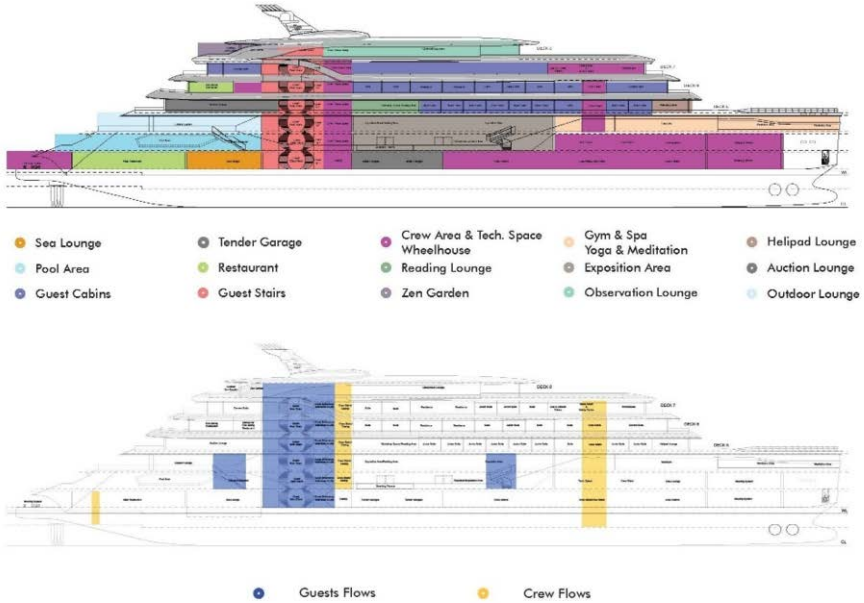


Figure 6. Symbiosis: hypothesis of zoning (AY 2024-25): Riccardo Etai Ahari, Gianluca Ferrante, Niccolò Marini, Paolo Spanu, Daniele Versace, Luca Gagliano

The primary types of lounges available on these ships include:

- **Main Lounge (80-120 m²):** This acts as the social hub of the ship, often hosting live performances, dancing, or group activities, featuring a stage, versatile seating, and a small bar area;
- **Observation Lounge (40-60 m²):** Usually found at the bow or upper deck, it boasts breathtaking panoramic views and a serene atmosphere, with comfortable seating perfect for enjoying the scenery in tranquillity;
- **Bar or Cocktail Lounge (50-70 m²):** This area is designed for entertainment and social interaction. It features a prominent bar and surrounding seating that encourages guest engagement;
- **Specialty Lounge (30-50 m²):** These smaller, unique spaces are dedicated to peaceful pursuits or niche entertainment, such as a library or a game room.

6.2 Functional Deck Layouts and Vertical Circulation

The redefinition of functional layouts plays a crucial role in enhancing passenger comfort and operational efficiency in the design of small luxury cruise ships. The internal organization of decks aims to ensure a seamless separation between guest and crew pathways, a concept derived from luxury hospitality arrangements. This spatial separation helps preserve privacy for guests while optimizing logistical operations for staff.

A clear distinction is made between service areas (such as kitchens, laundries, technical rooms, and crew quarters) and guest areas (cabins, lounges, wellness spaces, restaurants). Separate vertical circulation systems often serve these zones. Dedicated crew-only stairwells and elevators are positioned to avoid overlap with guest routes, ensuring discretion and reducing potential disturbances. Similarly, guest vertical circulation is streamlined and centralised around visually open and accessible spaces, such as atria or panoramic lift shafts, often connected directly to common areas.

The deck layout typically follows a tiered organization, where lower decks accommodate technical and crew facilities, middle decks are assigned to guest cabins, and upper decks host public and recreational areas. This hierarchy supports both efficient service workflows and intuitive guest navigation. The positioning of shared spaces, such as lounges or observation areas, on higher decks provides panoramic views and reinforces the sense of exclusivity and escape.

Incorporating these strategies brings luxury cruise ship design closer to that of mega yachts, where the architectural hierarchy emphasises comfort, intimacy, and functional clarity. This convergence of spatial logic ultimately elevates the overall cruise experience by supporting refined hospitality standards at sea.

6.3 Exclusive Destinations and Shore Experiences

A key feature of luxury cruises is their docking locations. Traditional cruise ships are often too large to access all ports, limiting their choices. In comparison, luxury cruise ships are smaller and can dock at lesser-known ports that larger vessels cannot reach, providing guests the opportunity to discover more remote and tranquil destinations. Typically, a port is not required for docking unless it is at capacity; in these cases, tender landings can be used to reach the mainland, even during peak traffic. This strategy can also reduce docking costs.

Some companies specifically design ships for luxury river cruises. The onshore experiences offered to guests on both yachts and luxury cruises are generally similar, although yachts deliver a more intimate maritime experience thanks to their smaller size. For example, some small luxury cruise ships come equipped with actual beach clubs that enhance the connection to the sea and surrounding nature. While shore excursions vary based on local options, luxury cruises often present exclusive tours for an additional charge, featuring different levels of luxury and customization. These excursions allow guests to partake in unique and privileged experiences, such as private tours or trips to secluded locations.

One particularly attractive aspect of luxury cruises is the opportunity to meet new people while enjoying a private and exclusive environment. Although privacy is a key element, diversifying social entertainment options aboard luxury cruise ships increases

the chances of meeting other passengers with similar interests, creating connections in a sophisticated setting.

Cruise ship entertainment typically falls under the category of "activities." This includes water sports toys such as jet skis, kayaks, paddleboards, and snorkelling equipment, all supplied by the crew, along with helicopter tours. Guests can enjoy cocktails in lounges with various live music performances and participate in interactive events like game shows. Many vessels also feature a mid-sized theatre that presents a nightly main show, highlighting international talents such as singers, comedians, musicians, and illusionists. Depending on the ship's itinerary, amenities like casinos or spas may also be available. Cultural entertainment is becoming an essential aspect of luxury cruises, which cruise companies increasingly recognise as an important part of the guest experience. This trend is especially true for smaller luxury and exploration vessels that weave cultural programming into their entertainment offerings, enhancing the overall traveller experience. People choosing these cruises often look for educational opportunities to engage with their destinations' local culture, history, cuisine, and wildlife. Guests typically prioritise eco-consciousness and aspire to understand and connect with local practices and the environment [13]. To strengthen the educational aspect, luxury cruise lines are increasingly hiring educators, experts, and presenters to give lectures and classes onboard. For example, on Alaskan cruises, naturalists share their insights about the wildlife encountered along the way [14].

Passengers on Hawaii or the South Pacific trips may also participate in hula dance lessons or learn to play the ukulele, often led by Polynesian ambassadors.

Scholars are invited to present lectures in various locations on distinct historical and cultural subjects, such as the Moai's history on Easter Island or presentations by marine biologists on marine biodiversity during cruises in Australia. This increasing emphasis on educational entertainment enriches the luxury cruise experience, evolving it from simple leisure to a source of cultural and intellectual depth [15].



Figure 7. *Contempla* (AY 2024-25): C. Ardenghi, M.E. Carbone, F. Raggi, A. De Angelis, M. Migliorini, C.Perrone



Figure 8. Rimor (AY 2024-25): Marco Claudio Cavallo, Adriano Publio Elio Panizzi, Elio Tublio, Edoardo Tommasi, Leonardo Camatta, Agnese Fanti, Nicola La Commare.

6.4 Itinerary Strategies and Onboard Experience Planning

The design of small luxury cruise ships is closely tied to their itinerary strategies and onboard programming. Small ships can access exclusive destinations with limited port infrastructure than larger vessels that follow high-capacity commercial routes. This capability directly influences ship design, particularly regarding draft, manoeuvrability and deck layout flexibility.

Onboard spaces are designed as multifunctional environments to support curated programming for each destination. Lounges can serve as lecture halls for cultural briefings during Arctic expeditions or be transformed into tasting rooms for local cuisine in the Mediterranean. Wellness decks, outdoor terraces, and panoramic lounges enhance the connection with the surroundings, adapting their function to the cruise context.

These ships follow seasonal itineraries, visiting regions during peak cultural or environmental times. This enables planning event-based experiences like art exhibitions, music performances, or culinary weeks aligned with local traditions. The adaptable interior configuration allows event planners to host immersive high-value activities without major structural changes.

The synergy between itinerary design and onboard layout thus becomes a strategic tool for delivering meaningful, immersive, and luxurious experiences, reflecting a shift from passive tourism to curated, event-driven exploration.

7. Innovation, Sustainability and Future Visions

The ships' design and configuration increasingly reflect their destinations' cultural identity. According to Verified Market Reports, the small luxury cruise market is expected to grow significantly in the coming years, with a remarkable compound annual growth rate (CAGR). This expansion is accompanied by an industry-wide shift toward sustainable practices, including adopting alternative fuels and partnerships with local communities to mitigate environmental and social impacts.

At the same time, growing demand for personalised experiences, such as themed cruises focused on wellness, gastronomy, or the arts, is helping to redefine the role of

small luxury cruises within the broader luxury tourism landscape. These trends point to a future in which innovation and sustainability converge to shape a more responsible and dynamic cruise offering.

In this context, future-oriented design concepts have begun to emerge, inspired by luxury vessels' distinctive aesthetic and functional features. Some scenarios envision annual itineraries aligned with natural seasonal cycles, visiting warm and culturally rich destinations throughout the year. These itineraries combine relaxation, exploration, and cultural immersion, offering guests season-specific experiences that foster a deeper connection with nature and local traditions.

The onboard spatial organisation promotes calmness, flexibility, and personalisation. Expansive outdoor areas facilitate wellness, creative activities, and social interaction. A central theme is integrating local culture and promoting artistic expression via events, exhibitions, and curated art auctions.

The envisioned amenities are panoramic lounges, wellness decks, meditation areas, art galleries, and multifunctional lounges designed for relaxation and creative programming. Complementary spaces may include fully equipped gyms, spas, reading lounges, and co-working environments, all conceived to blend comfort, productivity, and immersion in the voyage's natural and cultural context.

These emerging visions represent a synthesis of technical innovation, environmental responsibility, and experiential design, pointing toward new paradigms in the evolution of luxury cruising.

8. Conclusion

This research outlines a conceptual and design-oriented framework for next-generation small luxury cruise ships. By combining historical analysis, market trends, and original design investigation, it positions vessels of 100 to 150 meters in length, with a maximum of 100 passengers and a 1:1 crew-to-passenger ratio, as a distinct typology within the broader cruise sector.

The study demonstrates how this scale enables new levels of spatial quality, operational efficiency, and personalized experience, redefining the relationship between ship architecture and guest expectations. Unlike larger ultra-luxury vessels currently on the market, the proposed design principles are not merely responses to service standards but form the basis of the entire onboard spatial organization.

Through this lens, the paper contributes to expanding the discourse on luxury hospitality at sea, highlighting the potential of architectural design to shape future travel experiences where intimacy, flexibility, and cultural immersion become central.

Author Contributions

The authors wish to clarify that Chapters 1, 2, and 7 were edited by Mario Ivan Zignego; Chapters 3 and 4 by Elisabetta Proia and Chapters 5 and 6 by Davide Nicolini.

Acknowledgments

This study was developed within a broader academic research initiative that also includes the paper “An Innovative Approach to Sustainable Luxury Cruise Ship Design”, submitted for NAV 2025. Although the two papers are presented separately for clarity in the articulation of concepts, they originate from a unified research activity carried out collaboratively by all contributors.

The authors of this paper are the teaching staff of the Yacht Design Studio Workshop B, a design studio course offered within the Master's Degree Programs in Naval Engineering (DITEN) and Naval and Nautical Design (DAD). The research group also includes Massimo Musio-Sale, Angela Denise Peri, Lei Gao, Massimiliano Cavallin and Vito Zaccaro, affiliated with the University of Genoa, Department of Architecture and Design (DAD).

Within the workshop framework, students developed independent conceptual projects related to the themes explored in this study. While these student projects are not included in this publication, the studio served as a valuable space for reflection, experimentation, and the testing of design hypotheses.

Special thanks go to Architect Vittorio De Jorio and Engineer Giangiacomo Zino for their consultancy and passionate support during the development of the workshop activities.

References

- [1] Riccesi Donato, Gustavo Pulitzer Finali. *Il disegno della nave. Allestimenti interni (1925-1967)*, Marsilio, Milano 1 gennaio 1985, ISBN 8831748009
- [2] Zignego Mario Ivan, *Cruise Vessels Design*, Dogma, dicembre 2009, ISBN 9788887434439 pp. 122-1130
- [3] Musio-Sale Massimo, Zignego Ivan Mario, *New visions for future cruise ship vessels*, published online 15 october 2019, *International Journal on Interactive Design and Manufacturing (IJIDeM)* (2020) 14:19–33 <https://doi.org/10.1007/s12008-019-00615-1>
- [4] Bakker, M. (2005). *Luxury and tailor-made holidays*. Retrieved from <https://doi.org/10.13140/RG.2.1.2358.6968>
- [5] Gladkikh T., Séraphin H., Gladkikh V., Vo-Thanh T., (2022). *Luxury Yachting. Perspectives on Tourism, Practice and Context*. 55-73
- [6] Ingram, R. (2021). *The 2021 superyacht trends you need to know*. Forbes. Retrieved from <https://www.forbes.com/sites/rachelingram/2021/01/27/the-2021-superyacht-trends-you-need-to-know/>
- [7] Global Industry Analysts. (2021). *Global yacht industry industry*. Retrieved From https://www.reportlinker.com/p02284917/Yacht-Industry.html?utm_source=GNW
- [8] ROL Cruise. (2021). *Crystal Espirit cruises 2021: Crystal cruise ships*. Retrieved from <https://www.rolcruise.co.uk/cruise-lines/crystal-cruises/crystal-esprit>
- [9] Windstar. (2020). *How many people on a cruise ship*. Retrieved from <https://www.windstarcruises.com/blog/how-many-people-on-cruise/>
- [10] Seabourn. (2021b). *Seabourn homepage*. Retrieved from <https://www.seabourn.com/en/eu/global-search>
- [11] Spence, E. (2014). *Unraveling the politics of super-rich mobility: A study of crew and guest on board luxury yachts*. Retrieved from <https://doi.org/10.1080/17450101.2014.946772>
- [12] Bakker, M. (2005). *Luxury and tailor-made holidays*. Retrieved from <https://doi.org/10.13140/RG.2.1.2358.6968>
- [13] Lew, A. A. (2018). *Why travel? Travel, tourism, and global consciousness*. *Tourism Geographies*. Retrieved from <https://doi.org/10.1080/14616688.2018.1490343>
- [14] Manley, B., Elliot, S., & Jacobs, S. (2017). *Expedition cruising in the Canadian arctic: Visitor motives and the influence of education programming on knowledge, attitudes, and behaviours*. Retrieved from <https://doi.org/10.3390/resources6030023>

- [15] Travel Weekly. (2021). Forging fulfilment: Cruise lines bolster enrichment programs. Retrieved from <https://www.travelweekly.com/Cruise-Travel/Forging-fulfillment-Cruise-lines-bolster-enrichment-programs>

Author Index

Abbasi, A.A.	252	Bollentini, F.	38
Abdalla, E.	283	Bonaldo, D.	810
Abrami Y.D., S.	1105	Bonvicini, A.	1164
Acanfora, F.	1146	Bordignon, A.	77
Acanfora, M.	273, 881, 889	Borghese, P.	495
Accetta, A.	182	Borsellino, C.	283
Agnello, E.	856	Boullosa-Falces, D.	655
Aksozand, A.	388	Bozzo, S.	241
Alacqua, C.	898	Braga, F.	810
Alamanos, A.	449	Braidotti, L.	138, 156, 754, 980
Alan, S.	503	Brando, G.	999, 1009, 1066
Ali, D.	1154	Briguglio, G.	921, 1046
Altosole, M.	378, 881, 889	Brocco, E.	873
Angelici, G.	12	Brogli, R.	688
Angelov, A.	85	Brunello, A.	754
Angrisano, A.	606	Bruni, E.	429
Annetis, M.	567	Bucci, V.	138, 754, 980, 999, 1018, 1028
Argyros, M.	352	Buccini, C.	768
Azzellino, A.	459	Buonomano, A.	190
Baffigo, R.	643	Burak Korkmaz, K.	352
Bal Beşikçi, E.	503	Busetto, M.	112
Balsamo, F.	889	Busetto, P.	623
Barberi, E.	102	Busiello, C.	969
Barbieri, L.	102	Bussi, R.	128
Barbu, F.	598	Cadenaro, F.	623, 856
Bardazzi, A.	459	Calcagni, D.	643
Bardiani, J.	2	Callegari, S.	1172
Barone, G.	190	Campese, C.	95
Batalli, I.	856	Campos, J.A.	655
Becchetti, S.	262	Candido, A.	486
Belcore, O.M.	198	Canepa, E.	38
Belvisi, D.	476	Cangelosi, D.	1164
Bertagna, S.	138, 980, 999, 1009, 1018, 1028	Capasso, C.	46
Bertè, L.	262	Capobianco, M.	559
Bertirotti, A.	1082	Caprino, G.	768
Bet, D.	486	Caputo, A.C.	419, 528
Bionda, D.	112	Carcatera, A.	29
Biot, M.	2, 873	Carlo, D.	1127
Blandina, D.	898	Carroni, A.	559
Bocchetta, G.	419, 528	Carta, F.	56
Bocchetti, D.	378	Casas, W.J.P.	775
Bogar, M.	559	Casuscelli, F.	148

Cavallin, M.	734	Di Lecce, M.	1097
Cazzola, D.	208	Di Natale, F.	46
Cervicato, C.	688	Di Piazza, M.C.	174, 182
Chairi, M.	283, 909	Di Tomaso, F.S.	466
Chianese, C.	429, 881	Diez, M.	688
Chillemi, M.	293	Distefano, F.	921, 999, 1009, 1066
Chinese, T.	559	Dodaro, L.	439
Clematis, D.	208	Donnarumma, S.	313
Contestabile, P.	459	Dri, M.	1154
Coppola, M.	827	El Faziki, M.	655
Coppola, T.	120	Epasto, G.	948, 1009, 1038, 1056, 1066, 1075
Corigliano, P.	898, 909, 929, 958, 990	Ergas, I.	388
Corsi, P.	818	Eslamdoost, A.	352
Cosimo Tripoli, M.	112	Esposito, D.P.	388
Coslovich, F.	827	Fabris, L.	969
Crisafulli, D.	898, 929	Falchi, M.	56
Cristofano, A.C.	810	Falossi, M.	38
Crosato, A.	856	Fasano, E.	517
Crucil, M.	856	Federici, G.	29
Crupi, V.	921, 948, 990, 999, 1009, 1046, 1066	Ferrando, M.	241
Cucinotta, F.	102, 293	Ferrari, A.	864
D'Accardi, E.	1046, 1056, 1066, 1075	Ferrari, V.	331, 367
D'Amato, E.	802	Ferrazzi, F.	112
D'Ambra, A.	378	Figari, M.	476
D'Augusta, V.	846	Fina, A.	508
Dashtimanesh, A.	396, 408	Flagiello, D.	46
De Angelis, E.	148	Forzano, C.	190
De Carlini, M.	378	Franciosa, F.	810
De Cicco, S.	508	Franzosi, G.	252
De Finis, R.	1046, 1056	Freni, F.	921
De Luca, F.	396, 889	Frisoni, D.	1146
De Souza, R.	166	Gaggero, S.	313, 663
Degan, G.	835	Gaggero, T.	745
Del Buono, A.	688	Gaiotti, M.	655
Del Mondo, F.	166	Galietti, U.	1046, 1056, 1066
Del Papa, G.	190	Gao, L.	734
Del Piero, E.	156, 980	Garat, R.	576
Dell'Abate Di Fabio, M.	56	Garbatov, Y.	85, 948
Dell'Acqua, A.	835	Garcia, J.A.	449
Delogu, P.	112	Gazzaneo, L.	846
Denaro, A.	283	Gemelli, P.	1082
Deranian, C.	449	Gennaro, G.	864
Di Bella, G.	283, 909	Georgiev, P.	85
di Benedetto, M.	643	Giallanza, A.	216
Di Carolo, F.	1046, 1056, 1066, 1075	Giannella, M.	495
Di Felice, F.	439	Gilles, P.P.	655
Di Gangi, M.	198	Giorgianni, C.	1075
		Giorgianni, P.	948

Giudice, F.	1038	Maka, R.	190
Giurco, G.	835	Malabotti, S.	559
Giuzio, G.F.	190	Mancini, A.	56, 643
Gobbo, F.	21	Mancini, S.	352, 378, 396, 408, 889
Gomes, H.M.	775	Manfredi, K.A.	846
Gornicz, T.	331, 367	Marabello, G.	283, 909
Graziano, M.D.	810	Marchese, A.	1164
Greco, M.	459, 576	Marcilli, G.M.	486
Grizzi, S.	56	Marelli, G.	835
Gualeni, P.	674, 783	Marinò, A.	1009
Guano, N.	313	Marino, A.	231, 342
Gustin, G.	342	Marino', A.	156, 980, 999, 1018
Ha, J.	684	Martelli, M.	793
Hauninen, M.	655	Maslowska, A.	331, 367
Iafrati, A.	174, 182	Mastracci, F.M.	21
Iannace, S.	1172	Mauro, F.	2, 138, 547, 754
Ingargiola, R.	1164	Mazzeo, A.	810
Irace, A.	208	Mele, B.	323
Iuliano, A.	21, 148	Mendibil, A.	655
Jakovlev, S.	818	Micale, R.	216
John, P.K.	1046	Micoli, L.	120, 128
Kaufmann, N.	439	Migueluez, F.	655
Kivela, S.	655	Milana, S.	29
Koimtzoglou, A.	614	Milazzo, D.	331
Koundouri, P.	449	Minak, G.	95
Kyaw Oo D'Amore, G.	2, 873	Mio, A.	77, 112
La Guardia, M.	606	Miretti, F.	864
la Monaca, A.L.	77	Misul, D.A.	864
La Tona, G.	174	Mocerino, L.	46
Landucci, S.	1154	Montanini, R.	921
Laot, A.H.	655	Morgut, M.	827
Laurenza, G.	1154	Musio-Sale, M.	697, 723
Laurenza, M.	29, 775	Mussumeci, G.	606
Lavagnini, I.	559, 623, 632	Nardo, M.	856
Lavini, G.	342	Nechita, M.	655
Lenarduzzi, W.	655	Nguyen, D.T.	388
Lidozzi, A.	643	Niazmand Bilandi, R.	408
Lidtke, A.K.	331	Nicoletti, L.	846
Longo, F.	846	Nicolini, D.	707
Longo, G.	793	Nisiforou, O.	449
Louzis, K.	614	Noel, D.	1090
Lucarelli, A.	459, 466	Novello, F.	864
Lugni, C.	419, 429, 459, 466, 576	Padoano, E.	166
Luna A., L.D.	429	Padolecchia, D.	980, 1018, 1028
Luvisetto, C.	466	Padovano, A.	846
Maccari, A.	585	Pagani, L.	1082
Macocco, A.	128	Pais, T.	12, 655
Magnoni, L.	486	Palomba, G.	898, 909, 929, 958, 990
Maione, A.	688	Palombo, A.	190

Palumbo, D.	1046, 1056	Russo, R.	120
Panfiglio, S.	283	Russo, S.	459
Pennino, S.	273, 802	Rusu, E.-V.-C.	598
Pepe, G.	29, 775	Salmeri, F.	102
Peri, A.D.	697, 723, 1116	Salvatore, F.	439
Petacco, N.	674, 783, 810	Sanchez-Beaskoetxea, J.	655
Petkovic, G.	783	Sancin, G.	623, 856
Piaggio, B.	262	Sangermano, V.	388
Piana, E.	69	Scaccia, R.	56
Piccardo, S.	208	Scamardella, A.	273, 940
Piccione, F.	466	Scamardella, F.	46
Pigazzini, R.	889	Scarpa, M.	810
Pilloton, C.	459	Scattareggia Marchese, S.	948, 948
Pilutti Namer, T.	1137	Scherl, G.	429
Piscopo, V.	940	Scolaro, C.	1038
Pitruzzo, R.	224	Scotto, L.	262
Pivetta, D.	559	Şeker, M.	388
Pocevicius, E.	818	Serani, A.	688
Polimeni, A.	198	Severeide, K.	655
Popescu, G.	655	Sfravara, F.	293, 958
Potter, C.	576	Shagar, V.	174, 182
Previti, G.	1164	Sicchiero, M.	969
Pricl, S.	77	Sidari, M.	969
Proia, E.	707	Sili, A.M.	1038
Prpić-Oršić, J.	138	Soardi, F.	303
Pucci, M.	174, 182	Solina, V.	846
Quattrone, M.	929	Sorrentino, V.	378
Raffaele, M.	958	Sotiralis, P.	567, 614
Rasori, S.	38	Sparaci, F.	1146
Reina Illanes, Á.	388	Stan, L.-C.	598
Rezzante, F.	166, 559, 623, 632	Starzmann, R.	439
Rhee, S.H.	684	Stefanutti, L.	873
Rivarolo, M.	208	Stouraiti, A.	567
Rizzi, F.	224	Sulligoi, G.	495
Rizzo, C.M.	12, 655	Taccani, R.	166, 559, 632
Rizzo, D.	1038, 1075	Tacconi, R.	1154
Rizzuto, E.	745	Tagliamonte, E.	342
Rodono', G.	174, 182	Talarico, S.	846
Rognoni, G.	2, 873	Tani, G.	252
Roiaz, M.	623, 856	Taucer Marchesi, N.	980, 999, 1018, 1028
Rosano, G.	517, 547	Tavagnutti, A.A.	495
Roshan, F.	396	Tavakoli, S.	408
Rossi, A.	655	Thormodsæter, J.	655
Rossini, F.	810	Tocchi, F.	38
Rozza, G.	969	Tornielli, M.	1137
Ruggiero, V.	674, 1116	Twerda, A.	38
Russian, E.	623, 632	Ungureanu, C.	598
Russo, E.	793	Utzeri, S.	138, 156, 980
Russo, G.	190		

Valtananen, J.	655
Vavasori, P.	810
Ventikos, N.P.	567, 614
Vergassola, G.	12, 655
Vermiglio, E.	231
Vernengo, G.	303, 810
Vicenzutti, A.	495
Vicinanza, D.	429, 459
Villa, D.	241, 262, 663, 810
Visco, A.	1038
Viviani, M.	252, 262
Wayoe, S.K.	538
Younger, A.	388
Yuksel, O.	174, 182
Zaccone, R.	793
Zadeh, M.	388
Zanelli, M.	559
Zignego, M.I.	707, 1082
Zini, A.	783
Zizzania, S.	190
Zuliani, N.	559
Zuric, K.	166