



UNIVERSITÀ DEGLI STUDI DI GENOVA
SCUOLA POLITECNICA

DICCA, Dipartimento di Ingegneria Civile, Chimica e Ambientale

ANNUNCIO DI SEMINARIO

“When Stochastics Matters: New Pathways in Ship Design Using Stochastic Simulation-based Design Optimization”

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Martedì 22 Dicembre, 2015 – ore 14:30
Scuola Politecnica, Villa Cambiaso
Aula A11 (presso il DICCA)

Il seminario sarà tenuto in italiano o inglese, a seconda del pubblico presente.
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WHEN STOCHASTICS MATTERS: NEW PATHWAYS IN SHIP DESIGN USING STOCHASTIC SIMULATION-BASED DESIGN OPTIMIZATION¹

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Abstract

Assuming greenhouse gas emissions continue to drive global temperatures upward, a more hostile natural environment can be predicted, including rising averaged sea states and sea levels, and increased frequency of storms and extreme waves events. In maritime transport one will therefore have to consider not only the natural harshness of the environment, but also the effects of the climate changes, as well as the volatile status of the global energy and fuel market prices. To have an impact on the final designs, these elements have to be considered in the early stage of the ship design cycle, and optimal designs should be permeated with uncertainty (hence becoming robust!), because uncertainties permeate the real environment at any level. This motivated the development of stochastic simulation-based design optimization (SSBDO) methods, which have replaced the traditional build-and-test paradigm (costly and time consuming), providing opportunities for robust design decision, large design space exploration, and unconventional concepts. The confidence of the final solution relies on the use of accurate high-fidelity solvers, which have been constantly developed exploiting the increasing availability of high-performance computing systems. The SSBDO integrates three main elements: (a) geometry modification and automatic meshing, (b) analysis tools including high-fidelity solvers and uncertainty quantification methods, and (c) optimization algorithms. Its implementation represents an algorithmic and technological challenge, facing almost unaffordable computational costs. The seminar will present recent progress in efficient shape optimization for ship design, which includes design space dimensionality reduction techniques based on the Karhunen-Loève Expansion [1], uncertainty quantification methods for the ship performance in waves [2], hybrid global/local derivative-free optimization algorithms [3], and metamodels based on adaptive sampling procedures [4]. The applications will cover numerical studies, as well as their final experimental assessment [5].

References

- [1] Diez M., Campana E.F., Stern F., "Design-space dimensionality reduction in shape optimization by Karhunen-Loève expansion," *Computer Methods in Applied Mechanics and Engineering*, Vol. 283, pp. 1525-1544, 2015. DOI: 10.1016/j.cma.2014.10.042.
- [2] Diez M., Campana E.F., Stern F., "Development and evaluation of hull-form stochastic optimization methods for resistance and operability," FAST 2015, 13th International Conference on Fast Sea Transportation, Washington DC, USA, September 2015.
- [3] Serani A., Fasano G., Liuzzi G., Lucidi S., Iemma U., Campana E.F., Diez M., "Derivative-free global design optimization in ship hydrodynamics by local hybridization," 14th International Conference on Computer Applications and Information Technology in the Maritime Industries, COMPIT 2015, Ulrichshusen, Germany, May 2015.
- [4] Volpi S., Diez M., Gaul N.J., Song H., Iemma U., Choi K.K., Campana E.F., Stern F., "Development and validation of a dynamic metamodel based on stochastic radial basis functions and uncertainty quantification," *Structural and Multidisciplinary Optimization*, Vol. 51, No. 2, 2015, pp. 347-368. DOI: 10.1007/s00158-014-1128-5.
- [5] Diez M., Broglia R., Durante D., Campana E.F., Stern F., "Validation of high-fidelity uncertainty quantification of a high-speed catamaran in irregular waves," FAST 2015, 13th International Conference on Fast Sea Transportation, Washington DC, USA, September 2015.

¹ Work supported by the US Navy Office of Naval Research, NICOP grants N62909-11-1-7011 and N62909-15-1-2016