9 Conclusions

The proposed simulation approach, employed at the design stage, gives the designer insight into expected performance of a designed vessel, providing feedback that would otherwise be unavailable until the real system is built and tested.

This insight provides the possibility to check a number of design alternatives to optimize vessel design.

This Ph.D. thesis was inspired from a collaboration between Genova University and an important automation provider. The main target of this work was the development and use of simulation techniques for the propulsion control system design of a naval vessel. Thanks to the previously mentioned collaboration, it has been possible to apply the developed methods and models to a real industrial project. The principal objective has been well-achieved. The use of this kind of simulation platform to test the propulsion controller before the installation onboard enabled the automation provider to significantly reduce tuning time during sea trials. Furthermore, the simulation platform allowed the optimization of propulsion plant performance in terms of responsiveness, fuel consumption, and safety.

After the sea trials, the different models were validated. A good correlation between experimental and simulated data was observed. Obviously, some differences exist, and it is important understand the causes for future improvement. Generally, the differences between experimental and simulated data could be attributed to:

- Different conditions simulated
- Measurement uncertainties
- Missing data
- Assumptions used
- Numerical error

These potential sources for discrepancies could serve as future topics for further investigation in the ship design process.

The methodology and the simulation "*kernel*" developed and validated could become an invaluable multi-purpose tool for the maritime community (design studies, shipyard, automation provider, ship owners, crew, harbor authorities, classification register, etc.) because it allows the following tasks to be completed in a faster, more efficient manner:

- Size and optimize the propulsion plant
- Develop and optimize the propulsion control system
- Improve safety onboard
- Environmental assessment & IMO indicators
- Study maintenance programs
- Crew training
- Avoid collision in narrow water (harbor).