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A rapid assessment tool for the evaluation of ship hard grounding

In recent years, improved understanding of vessel response subjected to grounding became increasingly critical, primarily because of public concerns over several catastrophic accidents like environmental pollution, vessel capsizes and/or loss of human lives. Owing to lack of practical tools and methods, grounding accidents are understood based on limited statistical datasets, probabilistic approaches, and deterministic computational crashworthiness methods like those used by the automotive industry. Implementation of goal-based criteria in IMO Safety of Life at Sea has not been possible, because existing methods are computationally expensive and disregard idealisation of hydrodynamics, ship operation and seabed evasion. Under EU Horizon 2020 project FLARE, this project developed a time-domain, mathematical model and computational tool for the rapid evaluation of ship grounding dynamics. The model incorporates conventional rudder propeller configuration of a twin-screw ship manoeuvring in deep or shallow sea under calm-water/short-waves and ocean currents. The tool accounts for ship geometry, structural details/arrangements, and rock details. Following crashworthiness analysis, the damage, deformation energy, structural forces, ship motions, and evasive manoeuvres can be investigated. The study demonstrated reasonable comparison against computationally expensive methods. The method significantly reduces computation time from several days to a few seconds. The fluid-structure interaction methods developed push forward the state of the art in ship structural crashworthiness, can help shipyards and operators mitigate risks at early design stages and accordingly suggest risk control options for use in design development. The combination of manoeuvring and crashworthiness during grounding may enhance our understanding of the combined effects of structural crashworthiness on goal-based damage stability in design and operations.