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MULTISCALE METHODS FOR NAVAL SHIP STRUCTURES

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ABSTRACT

Multiscale computational methods are needed in the analysis of naval ships to reduce the cost of testing and assess their survivability for various requirement and scenarios. New Naval ships have composite topside, but could also exploit both composites and steel for the hull to achieve low weight, modularity, multi functionality, strength, stiffness, complex hydrodynamic shapes and reduced cost and maintenance. Hybrid composite / steel ship hulls will require massive computations to understand and assess their global performance (and locally at the steel-to-composite joints), under extreme dynamic loads, hull-girder sea loads, and slamming loads. Depending on the application, composite to steel joints are bolted (or fastened), adhesively bonded or both to achieve highest reliability and efficiency. There is also a new breed of composite-to-metal joints that exploits sculpted metal surfaces to achieve higher mechanical interlocking. Evaluation of ship damage and failure under various loading conditions, has to take into account effects defects, environmental degradation, such as corrosion, chemical and UV degradation, cyclic-temperature, and progressive damage. The complexity of composite-to-metal joints and lack of long-time experience with their performance at sea environment, is opening new field for multi scale computational methods, which are needed to avoid large scale testing programs. Such complexity, includes material interfaces, strain rate dependence of adhesives, coupled with local failures that can impact global dynamic behavior. In this presentation we will discuss currently funded multi scale efforts and the accompanying experimental testing for their evaluation and validation and the needs for further developments in this field.