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Holistic Modeling of Maritime Infrastructures Resilience

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All-encompassing nature of resilience creates a challenge for holistic coverage. United Nations (UN) defines resilience as an ability to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard. Comparable definition was adopted by the European Commission (EC) in a directive for critical infrastructure resilience. Guidance given by the UN on resilience considers a wide range of hazards from natural events to conflicts. The directive by EC considers all hazards, whether natural or man-made, accidental or intentional. To have abilities to protect, absorb, and recover from these threats one must design measures to ensure infrastructure resilience and assess their effectiveness.

One can deduce resilience to cover phases before, during, and after a disruption. These phases have widely different time scales. Certain threats are unlikely to occur but due to their severity one must consider them relevant. Severe accidents are often caused by a combination of minor events. Therefore, one must be able to detect minor disturbances and external factors. Especially for intentional threats, one must consider physical infrastructure protection against intruders. Ability to protect infrastructure against such threats depends on a cost-effective monitoring approach over the infrastructure's life cycle. The disturbing event such as an electrical fluctuation or an explosion may instead last for a fraction of a second. While the recovery from such an event may take weeks if not months.

These diverse time scales create a challenge to model resilience in different phases. This presentation introduces an approach being developed to model the resilience of maritime infrastructures. It encompasses agent-based modeling used in defense applications to cover infrastructure protection. The recovery is modeled with an event-driven approach where the challenge is the ability to access offshore infrastructures. The presentation further shows a model measuring offshore wind farm's ability to absorb electrical disturbances.