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FEM modelling of the mesoscopic section of a polyamide mooring subrope for floating offshore wind turbine; understand the friction to predict the fatigue life.

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ABSTRACT

Polyamide-fiber laid-strand ropes are candidate for the shallow-water mooring lines of the future floating offshore wind turbines [1]. Their mesoscopic scale follows a hierarchical architecture: subrope, strands, rope-yarns, yarns, filaments. Their mechanical behavior is the result of friction between components and the visco-elasto-plastic behavior of the filament matter. Under cyclic loading, a fatigue damage based on the component frictions occurs and is a matter of concern for a 20-year service life. Friction phenomena at the different scales are difficult to obtain experimentally. So, we adopted a modelling approach for understanding the frictions.

We adopted Charmetant's model [2] for describing the deformations within the subrope until the scales of the strand and rope-yarn. Actually, the subrope will be modelled by the quasi-static FEM as three helical strands in contact with each other. Each strand will be meshed by volumic finite elements, at integration points of which a user-routine behavior law is implemented. As Charmetant et al. showed, this behavior law will distinguish the friction strain modes from the filament matter strain mode within the global deformation gradient undergone by the bundle of rope-yarns. For each of these strain modes, a dedicated and relevant behavior law is proposed. One friction strain mode is a differential displacement of the rope-yarns in the direction of their axis, identical to a shear mode.

Experimental tests are dedicated to identify the model parameters, while, by using other dedicated experimental results, we can afford to test or validate the model predictions.

REFERENCES

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