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## Numerical simulations of the sails aerodynamics for a 16th century Portuguese nau

The discovery and archaeological excavation of the "Nossa Senhora dos Martires" wreck in the Tagus river between 1996 and 2001 renewed the interest in studying the ships (naus) that were used for transporting people and goods between Portugal and India in 16th and 17th centuries. A reconstruction of the hull, including above waterline structures, of the masts, yards and sail plan was carried out using the archaeological data, contemporary documents and iconography. In the present paper, the aerodynamics of the sails of the nau is numerically simulated. The reconstructed model of the nau is used as geometry input. While the sailplan was reconstructed based on scientific evidence, the sails' shape is determined using an heuristic method. Several combinations of wind incidence angle and yards angles with respect to the centre line of the hull are used. The simulations consider turbulent flow and are performed using the commercial code Star-CCM+.

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