The notion of wind Finsler structure is developed. This a generalization of Finsler metrics where the indicatrices at the tangent spaces may not contain the zero vector. In the particular case that these indicatrices are ellipsoids (called here wind Riemannian structures), they admit a double interpretation which provides: (a) a model for Zermelo's navigation problem even when the trajectories of the ships are influenced by strong winds or streams, and (b) a natural description of the causal structure of relativistic spacetimes endowed with a non-vanishing Killing vector field K (SSTK spacetimes), in terms of Finslerian elements. These elements can be regarded as conformally invariant Killing initial data on a partial Cauchy hypersurface. The links between both interpretations as well as the possibility to improve the results on each interpretation by using the other viewpoint, are stressed.

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