Hierarchical Principle of Construction of Spatial DP Systems of Sea Mobile Objects (SMO)

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Abstract

The hierarchical principle of synthesis of dynamic positioning systems for sea mobile objects is offered at the given arrangement of the thrusters. The method consists in synthesis of vectors of controlling forces and moments ensuring dynamic positioning of object with given quality (management of the top level) and the subsequent distribution of these forces and the moments on the thrusters (formation of management of the bottom level). The offered approach for management of the top level is based on a method of functions Lyapunov and allows to synthesize nonlinear control laws ensuring exponentially stable positioning SMO.

It is supposed, that the number of the thrusters, their arrangement and directions of vectors of action of their forces (is usual in body-fixed reference frame) satisfy to the offered criterion controllability and provide sole or infinite number of the decisions of a task of distribution of managements. In the latter case is possible optimum somewhat distribution of a vector of controlling force and moment of the top level on the thrusters. It is necessary to note, that the spatial task of management of the bottom level has features, connected that skew-symmetrical a matrixes in the equations of distribution of the managing moments, are special. In this connection many such tasks were reduced to frame (for which these features are absent), if the behavior of movement allowed such division (for example, at a small roll). In the given work   an arrangement of thrusters is offered which allows and in a spatial case to reduce a task of distribution of resources of management to frame case without restrictions on a behavior of movement.

The managing forces of the bottom level are realized as inputs on the executive drives, which have own dynamics and, accordingly, delays. In additional, the tractions of executive drives usually are rather limited, that can result in unstable behaviors. Are considered ways of formation of the top-level management for the established behaviors (small initial deviations and at presence of various external influences limited on size) and the for transfer processes (large initial deviations).

The report is illustrated by an example of synthesis of system of dynamic positioning for some SMO.

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