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Synthesis Of The Control System Of Vectored Thruster Underwater Vehicle Spatial Motion

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ABSTRACT

In the given work the method of synthesis of the control law of vectored thruster AUV movement is offered. This control law allowing to provide its exact moving on the desirable trajectory in the conditions of limited capacity of its thruster complex. The given control system considers not only dynamic error, but also a deviation from the desirable trajectory, and desirable laws of trajectory movement. Besides, in work the algorithm of transformation of parameters of movement on a desirable trajectory is offered. This algorithm allows to consider indirectly capacity restrictions thruster complex and to change desirable movement parameters on a trajectory..

KEY WORDS: underwater vehicle; control system; vectored thruster; trajectory control.

INTRODUCTION

Recently at performance of various underwater works (inspection of underwater communications, search and rescue works, etc.) the increasing value gets use of autonomous underwater vehicles (AUV). And in the course of performance of these works AUV should carry out difficult maneuvers, moving on the set spatial trajectory with the maximum velocity and accuracy.

One of the most perspective AUV concepts is vectored thruster AUV (Cavallo, 2004). Use only one rotary thruster allows to provide the big autonomy of work, high velocity of movement at the expense of the streamline form of the case, and also high maneuverability on low speeds. However along with the specified essential advantages thruster complex of these AUV does not allow to form independently an thrusts and the moments on various degrees of freedom of AUV. The specified circumstance can lead to that at the high speed of movement on the desirable trajectory this AUV can deviate from this trajectory, because the part of power of the single thruster will be spent for creation of the moments of turn. The described problem can be solved at the expense of use of a special control system which would trace the given situation and corrected movement parameters on a trajectory.

Control systems of dynamic objects including AUV, basically are focused on control in a tracking mode, that is as an entrance signal of a control system the value of AUV dynamic error by position and speed (Filaretov, 2001) is used. However in a considered case approaches to synthesis of such control systems are suitable only partially, because a control signal is restricted and the specified methods cannot provide exact movement on the desirable trajectory. Thus in places enough the big curvature of a trajectory the using of the specified control laws can lead to "cutting" of these sites of a trajectory and, hence, to collisions with a surface

To provide exact AUV movement on the desirable spatial trajectory it is necessary to form the control influences not only depending on value of a dynamic error, but also depending on distance between AUV and a desirable trajectory of movement. Introduction of this additional correction can lead to a situation of arrival the control influences in saturation. In this case it is necessary to automatically reduce desirable velocity of movement on the desirable trajectory, that is to correct the reference signals arriving on an input of a control system.

There is a considerable quantity of the works devoted tracking control of mobile robots (Repoulias, 2005; Fossen, 1994). However these works consider cases when desirable speed of movement on a trajectory can be provided by power of thruster complex of this robot that can be not always executed. For example, in case of change of parameters of the robot (increase in its weight at the expense of the taken cargo), malfunctions thruster complex, reduction of capacity of power supplies etc. In this case existing approaches do not allow to provide exact movement on the desirable trajectory.

TASK SETTING

Thus, in the given work the problem of synthesis of such control system which would allow AUV to move precisely on the desired spatial trajectory in the conditions of restrictions on control influences is put and solved.

Thus the primary goal consists in synthesizing system of correction of desirable control signals which will form new setting signals, being based on the information on a desirable trajectory and parameters of AUV movement. These new setting signals should be formed so that they coincided with initial in a case when power of AUV thruster