**Theorem 5.** *Assume that there exists a neighborhood $U$ of the origin and a continuous function $V : U \to \mathbb{R}$, such that the following conditions are satisfied:*

1. $V(0) = 0$;
2. *given* $\alpha > 0$ *there exists* $p \in B(0, \alpha)$, *such that* $V(p) > 0$;
3. $V(x(k+1, x_0)) \geq V(x(k, x_0)) \geq 0$ *for every solution* $x(k, x_0) \in U$ *and* $\forall k = 1, 2, \dots$;
4. *for every* $x_0 \in U$, *we have* $\gamma^+(x_0) \not\subset E = \{x \in U : \; V(x) = V(f(x)) \text{ and } V(x) \neq 0\}$.

*Then* 0 *is an unstable equilibrium point of system* (2).

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# PERFORMANCE OF PROGRAMMED SPATIAL PATHS OF AUTONOMOUS UNDERWATER ROBOTS


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Nowadays various robots are developed and used for deep-water operations and oceanic research. The advances in marine technologies are largely due to the development of autonomous equipment including autonomous unmanned underwater vehicles (AUV), i.e. underwater robots which are particularly effective for operations at great depths.

The results represented in the paper are based on the many years of experience of the Institute of Marine Technology Problems (IMTP) FEB RAS in developing and using AUVs for object survey, geological sea-bed survey, hydroacoustic and gravimetric measurements and some other surveys on the shelf and at great depths [1, 2].

Depending on the nature and complexity level of the tasks to be performed using the AUV we can distinguish the following category of control and the corresponding spatial motions where the "intelligent" behavior elements are present the most: [3]:

- Implementation of a planned or correctable path network for area, object or physical fields search or survey;
- Route selection in the rugged bottom topography for a goal-oriented search where the vehicle is to reach the intended area;
- Maneuvering within a limited area or point positioning during close object survey, structure inspection, rendock with mooring facilities or homing beacons;
- Spatial motion including positioning data correction and reference generation based on variability of measurable environment parameters and current vision system data;
- Optimization of control system parameters when vehicle missions or environment change.

The paper deals with the peculiarities of dynamic model of the autonomous underwater robot [4] and implementation of programmed motion taking into account contradictory requirements of stability and accuracy depth stabilization or equidistant curve with regard to relief. It also gives examples of practical realization of the offered solutions in the structure and algorithms of motion control of certain autonomous underwater vehicles-robots.

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# GLOBAL POSITIONAL SYNTHESIS AND FINITE-TIME STABILIZATION OF MIMO GENERALIZED TRIANGULAR SYSTEMS BY MEANS OF CONTROLLABILITY FUNCTION METHOD


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We solve the problem of global stabilization in finite time by means of a continuous feedback law for a general class of tridiagonal multi-input and multi-output systems with singular input-output links. We combine the controllability function method (which works locally around the equilibrium) with a modification of global construction developed in previous works for the singular case.


# ABOUT EXTREMALITY, STATIONARITY, AND REGULARITY


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**Introduction.** Extremality, stationarity, and regularity properties of collections of sets in a normed linear space are characterized in terms of certain primal and dual constants.

**1. Primal Constants.** Consider a collection of sets $\Omega_1, \Omega_2, \ldots, \Omega_n$ $(n > 1)$ in a normed space $X$ with $x^\circ \in \cap_{i=1}^n \Omega_i$. The following nonnegative (not necessarily finite) constants can be used for characterizing the mutual arrangement of the sets near $x^\circ$ [1, 2, 4, 3, 5]:

$$\theta_\rho[\Omega_1, \ldots, \Omega_n](x^\circ) = \sup\{r \geq 0 : \left(\bigcap_{i=1}^n (\Omega_i - a_i)\right) \bigcap (x^\circ + \rho B) \neq \emptyset,\ \forall a_i \in rB\},$$

$$\theta[\Omega_1, \ldots, \Omega_n](x^\circ) = \liminf_{\rho \to +0} \frac{\theta_\rho[\Omega_1, \ldots, \Omega_n](x^\circ)}{\rho},$$

$$\hat{\theta}[\Omega_1, \ldots, \Omega_n](x^\circ) = \liminf_{\substack{\omega_i \xrightarrow{\Omega_i} x^\circ \\ \rho \to +0}} \frac{\theta_\rho[\Omega_1 - \omega_1, \ldots, \Omega_n - \omega_n](0)}{\rho}.$$