On a problem of parametric control of trajectories ensemble

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The work is concerned to the task of optimal control of trajectories ensemble (or beam) of nonlinear dynamic system. Such problems arise when solving applied control problems of an object with incomplete information [1]. Problem statement for ensembles of trajectories differs from those for a single trajectory, the target functionals depend on the sets. Optimal control for the ensemble is a computationally hard, so we propose to combine numerical methods of reachable set approximation and optimal control methods. Let us consider dynamical system on time interval $t \in T = [t_0, t_1]$

$$x = f(x(t), w(t), v, t) \tag{1}$$

where, $x = (x_1, ..., x_n)$ is phase vector, w is external disturbance limited as $w \in W = [\underline{w}, \overline{w}]$, and v is control parameters vector $v \in [\underline{v}, \overline{v}]$, initial conditions is defined $x(t_0) = x^0$. Suppose $f(x, w, v, t)$ to be continuous differentiable.

In this paper, the ensemble of trajectories will be generated by the disturbance, i.e. the ensemble with the control parameters $\hat{v}$ we call the family of trajectories $x = x(x_0, w(t), \hat{v}, t)$ corresponding to a various realizations of the disturbance w from a given set W. Section of ensemble we call $M_(t, v)$ by the system (1) and control v at time t. At the moment we limits examined problem by only two statement: standard and maximum deviation.

We propose an approach to the solution of the problem based on the approximation of the ensemble section with the use of algorithms developed for reachable set approximation. The most promising methods seem to be represented by stochastic and piecewise linear boundary approximation. The value of terminal functional evaluated on the set of obtained reachable points. Computational experiments showed the principal possibility of solving the problem when using a sufficiently dense coating to a variety of disturbances, and the adequacy of the approximate calculation of the functional in this case.

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References

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