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About a class of problem of pursuits in controlled distributed systems

The problem of pursuit of a following considered

$$\sum_{\alpha=1}^{m} \frac{\partial}{\partial x_\alpha}\left(A^{(\alpha)}(x)\frac{\partial z}{\partial x_\alpha}\right) + \sum_{\alpha=1}^{m} B^{(\alpha)}(x)\frac{\partial z}{\partial x_\alpha} - C(x)z = -u + \upsilon\,, \quad z(x) = 0\,,\ x \in \Gamma\,, \quad (1)$$

where $z = z(x) = (z^1(x), z^2(x), \dots, z^{m_0}(x))$, $x = (x_1, x_2, \dots, x_p) \in \omega \subset R^p$, $p \geq 1$, $\bar\omega = \{0 \leq x_\alpha \leq 1,\ \alpha = 1, 2, \dots, p\}$ with border Γ, $A^{(\alpha)}(x)$, $B^{(\alpha)}(x)$ diagonal matrixes $m_0 \times m_0$, which units is, accordingly $a_\alpha^{(m)}(x)$, $b_\alpha^{(m)}(x)$, $C(x)$ — square matrix with units $c^{(mm)}(x)$, $a_\alpha^{(m)}(x)$, $b_\alpha^{(m)}(x)$, $c^{(mm)}(x) \in C^1(\bar\omega)$; $u \in \bar P$, $\upsilon \in \bar Q$ control functions, from a class $L_2(\omega)$. In R^{m_0} the terminal set $\bar M_1$ is allocated. Game is considered ended, if $z(\tilde x) \in \varepsilon S + \bar M_1$, where S — an individual sphere from R^{m_0}. The differential problem for system (**??**) on a grid $\bar\omega = \omega \cup \gamma$ with border γ looks like

$$\frac{1}{h^2}\sum_{\alpha=1}^{m}\left[A^{(\alpha)}_{i_\alpha-\frac12,k} z_{i_\alpha-1,k} - \left(A^{(\alpha)}_{i_\alpha-\frac12,k} + A^{(\alpha)}_{i_\alpha+\frac12,k}\right) z_{i,k} + A^{(\alpha)}_{i_\alpha+\frac12,k} z_{i_\alpha+1,k}\right] +$$

$$+\frac{1}{2h}\sum_{\alpha=1}^{m} B^{(\alpha)}_{i,k}(z_{i_\alpha+1,k} - z_{i_\alpha-1,k}) - C_{i,k}z_{i,k} = -u_{i,k} + \upsilon_{i,k}\,,$$

$$z_{i,k} = z_{i_1,i_2,\dots,i_s,k} = 0, \quad i_\alpha = 0, r; \quad \alpha = 1, 2, \dots, s; \quad k = 0, 1, \dots, \theta\,. \quad (2)$$

To take into space R^{m_0H} (here H — total number of knots belonging in ω) vector net functions, we will define in it scalar product and correcting the right member of equation (**??**) in frontier knots, we will write down differential problem (**??**) in the form of $A\tilde z = -\tilde u + \tilde\upsilon$, $\tilde z, \tilde u, \tilde\upsilon \in R^{m_0H}$. Applying Richardson's [**?**] iterative method, we will receive the following game problem

$$\tilde z_{n+1} = (I - A)\tilde z_n - \tilde u_n + \tilde\upsilon_n, \quad \tilde u_n \in P, \quad \tilde\upsilon_n \in Q\,. \quad (3)$$

Let $M = M_0 + M_1$, where M_0 — linear subspace R^{m_0H}, M_1 — subset a subspace L — orthogonal addition M_0 in R^{m_0H}, Π matrix orthogonal designing from R^{m_0H} on L, $P = \underbrace{\bar P \times \bar P \times \ldots \times \bar P}_{H}$, $Q = \underbrace{\bar Q \times \bar Q \times \ldots \times \bar Q}_{H}$, $M_1 = \underbrace{\bar M_1 \times \bar M_1 \times \ldots \times \bar M_1}_{\mu}$, $1 \leq \mu \leq H$

and $W(0) = \{0\}$, $W(n) = M_1 + \sum\limits_{i=0}^{n-1}\left[\Pi(I-A)^i P \overset{*}{-} \Pi(I-A)^i Q\right]$, $n = 1, 2, \dots$.

Theorem. *Suppose that N — least of those numbers n, for each of which takes place inclusion $\Pi(I-A)^n\tilde z_0 \in W(n)$. Then in game (**??**) from a point $\tilde z_0$ can be completed after N steps.*

[1] Hageman L., Yong D. Applied iterative methods. — Academic Press 1981. — P. 448.