INTEGRAL BELGI OSTIDA ARALASH MAKSIMUMLI DIFFERENSIAL TENGLAMALAR UCHUN SHARTLI BOSHLANG’ICH MASALA

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Annotatsiya: Ushbu maqolada quyidagi chiziqli bo’lmagan maksimumli differensial tenglama uchun boshlang’ich masala ,Chiziqli bo’lmagan filtrlash masalasini sonli yechib cho’kmaning oshib borishi ham monoton ortib borishi ko’rsatildi., integral belgi ostida aralash maksimumli differensial tenglamalar uchun ulash shartli boshlang’ich masala, o’rganilgan.

Kalit so’zlar: Boshlang’ich shart, vector funksiyasi, cheklangn yopiq to’plam, differensial tenglama, yevklid normasi, matematik induksiya metodi.

ИСХОДНАЯ ЗАДАЧА С УСЛОВИЕМ СВЯЗИ ДЛЯ СМЕШАННЫХ МАКСИМАЛЬНЫХ ДИФФЕРЕНЦИАЛЬНЫХ УРАВНЕНИЙ ПОД ЗНАКОМ ИНТЕГРАЛА

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Аннотация: В этой статье исходной задачей для следующего нелинейного максимального дифференциального уравнения является , Путем численного решения задачи нелинейной фильтрации было показано, что увеличение количества осадков также монотонно увеличивает исходную проблему, изучаемую**.**

Ключевые слова: начальное условие, векторная функция, конечное замкнутое множество, дифференциальное уравнение, евклидова норма, метод математической индукции.

AN INITIAL PROBLEM WITH A CONNECTION CONDITION FOR MIXED MAXIMAL DIFFERENTIAL EQUATIONS UNDER THE INTEGRAL SIGN

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Abstract: In this article, the initial problem for the following nonlinear maximum differential equation is 3. By numerically solving the nonlinear filtering problem, it was shown that the increase in precipitation also increases monotonically. initial issue, studied.

Keywords: Initial condition, vector function, finite closed set, differential equation, Euclidean norm, mathematical induction method.

$$x'(t) = F(t, x(t), \max\{x(r) \mid r \in [f \mid g]\}), \qquad t \in [0;T]$$

Bizga quyidagicha boshlang'ich shart berilgan

$$x(0) = \varphi_0 < \infty$$

Bu yerda $x \in X \subset R^n$ noma'lum vector funksiyasi, X -cheklangn yopiq to'plam

$$0 < f = f\left(t, \int_r^t K(t,s,x(s))ds\right) \le T \qquad 0 < g = g\left(t, \int_r^t Q(t,s,x(s))ds\right) \le T$$

$$x^{(1)}(t) = A + \int_0^t F(s, x^{(1)}(s), \max\{x^{(1)}(r) \mid r \in [f^{(1)}, g^{(1)}]\})ds, \ t \in T^{(1)},$$

$$x^{(2)}(t) = B + \int_0^t F(s, x^{(2)}(s), \max\{x^{(2)}(r) \mid r \in [g^{(2)}, f^{(2)}]\})ds, \ t \in T^{(2)},$$

(1) Boshlang'ich shartdan foydalanib, (3) quydagicha ko'rinishga keltiramiz

$$x^{(1)}(t) = I(x^{(1)};t) = \varphi_0 +$$
$$+\int_0^t F(s, x^{(1)}(s), \max\{x^{(1)}(r) \mid r \in [f^{(1)}, g^{(1)}]\})ds, \ t \in T^{(1)},$$

(4) differensial tenglamada B koeffesentni topish uchun qo'shimcha shart kiritib olamiz

$$x^{(2)}(+\overset{*}{t}) = \alpha x^{(1)}(-\overset{*}{t}), \ \alpha - const.$$

(3) Va (6) asosida (4) ni quyidagicha yozamiz

$$x^{(2)}(t)=J(x^{(2)};x^{(1)};t)=\alpha x^{(1)}(\overset{*}{t})+$$
$$+\int_0^t F(s,x^{(2)}(s),\max\left\{x^{(2)}(r)\mid r\in\left[g^{(2)},f^{(2)}\right]\right\})ds,\ \ t\in T^{(2)},$$

Keling isbotlaylik.

Lemma . Quyidagilar o'rinli bo'lsin

1. $0\le f(t,y)<g(t,y)\le T,\ \ t\in T^{(1)},\ \gamma=0$
2. $F(t,x,z)\in C(T^{(1)}\times X_1\times X_1)\cap Bnd(M_1)\cap Lip(L_{1|x,z})$
3. $f(t,y)\in C(T^{(1)}\times R^n)\cap Lip(L_{2|y});$
4. $g(t,y)\in C(T^{(1)}\times R^n)\cap Lip(L_{3|y});$
5. $K(t,s,x)\in C(T^{(1)}\times T^{(1)}\times X_1)\cap Lip(P_{1|x}(t,s));$
6. $Q(t,s,x)\in C(T^{(1)}\times T^{(1)}\times X_1)\cap Lip(P_{2|x}(t,s));$

Bu yerda $\|\cdot\|$ yevkelid normasi R^n sohada.

$T^{(1)}$ segmentda (5) differensial tenglamaning yagona yechimi mavjud.

Isbot. $T^{(1)}$ segmentda (5) differensial tenglama uchun integral jarayon quyidagicha tuziladi.

$$x_0^{(1)}(t)=x_0,\ \ x_{k+1}^{(1)}(t)=I(x_{k+1}^{(1)};t),\ \ k\in N_0$$

Bu yerda $N\equiv\cup\{0\}$, N -natural sonlar to'plami.

$x_k^{(1)}(t),k\in N_0$ ketma-ketlik $X_1\subset R^n$ sohaga tegishli.

Biz quyidagicha belgilashlarni olamiz

$$\rho_i^{(j)}(t)=\left\|x_i^{(j)}(t)-x_{i-1}^{(j)}(t)\right\|,\ \ f_k^{(j)}=f\left(t,\int_0^t K(t,s,x_k^{(j)}(s))ds\right),$$

$$q_k^{(j)}(t)=q\left(t,\int_0^t Q(t,s,x_k^{(j)}(s))ds\right),\ k=1,2,.....$$

$$\rho_{ir}^{(j)}(t)=\left\|\max\left\{x_i^{(j)}(r)\mid r\in\left[f_i^{(j)}\mid q_i^{(j)}\right]\right\}-\max\left\{x_{i-1}^{(j)}(r)\mid r\in\left[f_{i-1}^{(j)}\mid q_{i-1}^{(j)}\right]\right\}\right\|$$

$$\rho_{i[i]}^{(j)}(t)=\left\|\max\left\{x_i^{(j)}(r)\mid r\in\left[f_i^{(j)}\mid q_i^{(j)}\right]\right\}-\max\left\{x_{i-1}^{(j)}(r)\mid r\in\left[f_i^{(j)}\mid q_i^{(j)}\right]\right\}\right\|$$

(8) shartdan foydalanib, (14) ni $k=1$ uchun quyidagicha olamiz

$$\rho_2^{(1)}(t) \le L_1 \int_0^t \left[\rho_1^{(1)}(s) + \rho_{1r}^{(1)}(s) \right] ds, \ \ t \in T^{(1)}$$

Chunki

$$\rho_2^{(1)}(t) \le \max\left\{ \rho^{(1)}(t) \,|\, t \in T^{(1)} \right\} \le Mt$$

U holda (15) quyidagicha ko’rinishga ega bo’ladi

$$\rho_2^{(1)}(t) \le 2M_1 L_1 \frac{t^2}{2}, \ \ t \in T^{(1)}$$

Xuddi shunday (15) ni (14) da $k = 2$ dan kelib chiqib quyidagicha olamiz

$$\rho_3^{(1)}(t) \le L_1 \int_0^t \left[\rho_2^{(1)}(s) + \rho_{2r}^{(1)}(s) \right] ds, \ \ t \in T^{(1)}$$

(17) ning o’ng tomonidagi ifoda uchun ikkinchi shart asosida quyidagicha baho o’rinli

$$\rho_{2r}^{(1)}(t) \le \left[\rho_{2r[2]}^{(1)}(t) + \rho_{2r[1]}^{(1)}(t) \right], t \in T^{(1)}$$

(17) ni hisobga olgan holda , (18) ning o’ng tomonini birinchi shart asosida quyidagicha baholaylik

$$\rho_{2r[2]}^{(1)}(t) \le 2M_1 L_1 \frac{t^2}{2}, \ \ t \in T^{(1)}$$

(9)-(13) va (17) hisobga olgan holda, (18) ning o’ng tomonini ikkinchi shart asosida quyidagicha baholaylik

$$\rho_{2r[2]}^{(1)}(t) \le M_1 \left[\left| f_2^{(1)} - f_1^{(1)} \right| + \left| q_2^{(1)} - q_1^{(1)} \right| \right] \le$$

$$\le M_1 \int_0^t \left[L_2 \left\| P_1(t,s) \right\| + L_3 \left\| P_2(t,s) \right\| \right] \rho_2^{(1)}(s) ds \le$$

$$\le M_1 \beta \max\left\{ \rho_2^{(1)}(t) \,|\, t \in T^{(1)} \right\} \le$$

$$\le 2M^2{}_1 L_1 \frac{t^2}{2}, \ \ t \in T^{(1)}$$

(18) ga (19) va (20) almashtirishlarni olib, quyidagini hosil qilaylik

$$\rho_{2r}^{(1)}(t) \le 2M_1 L_1 (1 + M_1 \beta) \frac{t^2}{2}, \ \ t \in T^{(1)}$$

U holda (17) quyidagicha ko’rinishga keladi

$$\rho_{3r}^{(1)}(t) \le 2M_1 L_1 (2 + M_1 \beta) \frac{t^3}{3!}, \ \ t \in T^{(1)}$$

Xuddi shunday (17)-(21) $k=3$ uchun olamiz .

$$\rho_{4r}^{(1)}(t)\le L_1\int_0^t\left[2\max\left\{\rho_{3r}^{(1)}(s)\middle|0\le s<t\le \overset{*}{t}\right\}+\right.$$

$$\left.+M_1\beta\max\left\{\rho_{3r}^{(1)}(s)\middle|0\le s<t\le \overset{*}{t}\right\}\right]ds\le$$

$$\le 2M_1L_1^3(2+M_1\beta)^2\frac{t^4}{4!},\quad t\in T^{(1)}$$

Ushbu jarayonni davom ettirib, $\forall k\in N_0$ uchun to’liq matematik induksiya metodidan foydalanib, quyidagini olamiz

$$\rho_{k+1}^{(1)}(t)\le 2M_1L_1^k(2+M_1\beta)^{k-1}\frac{t^{k+1}}{(\kappa+1)!},\quad t\in T^{(1)}$$

(22) da $\{x_k^{(1)}(t)\}$ ketma-ketlik t da bir xilda yaqinlashishini ko’ramiz. Bundan kelib chiqadiki, $\{x_k^{(1)}(t)\}\to x^{(1)}(t)$ uchun $k\to\infty$ bo’lsa, $x^{(1)}(t)$ (5) tenglamaning yechimi, demak, (5) sistemaning yechimi mavjudligini isbotladik.

Endi biz bu yechimning yagona ekanligini isbotlaylik. Xuddi shunday (5) differensial tenglama boshlang’ich shartga ko’ra $T^{(1)}$ segmentda boshqa $y(t)\in X_1$ yechimga ega bo’lsin. $y(t)$ va ketma-ketlik $x^{(1)}(t),\ k\in N_0$ larni farqini ko’raylik, ular uchun quyidagicha baho o’rinli

$$\left\|y(t)-x_k^{(1)}(t)\right\|\le 2M_1L_1^k(2+M_1\beta)^{k-1}\frac{t^{k+1}}{(\kappa+1)!},\quad t\in T^{(1)}$$

(23) da quyidagicha ko’rinishga keladi

$$\left\|y(t)-x_k^{(1)}(t)\right\|\to\infty$$

$k\to\infty$ da teng ravishda $t\in T^{(1)}$. $T^{(1)}$ segmentda (5) differensial tenglama yagona yechimga ega bo’ladi.

ADABIYOTLAR;

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