KICHIK PARAMETRGA EGA BO'LGAN CHIZIQLI BO'LMAGAN TENGLAMALAR SISTEMASINING DAVRIY YECHIMLARI HAQIDA

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Annotatsiya:
Quyidagi ko'rinishga ega bo'lgan chiziqli bo'lmagan ayirmali tenglamalar sistemasini qaraymiz.

$$x(t+1) = Ax(t) + F(t, x(t), y(t), \varepsilon), \qquad (1)$$
$$y(t+1) = By(t) + \Phi(t, x(t), y(t), \varepsilon),$$

Kalit so'zlar: tenglamalar sistemasi, cheksiz, ayirmali tenglamalar , qanoatlantiruvchi , vektorlar.

Bunda A,B - haqiqiy o'zgarmaslarga ega bo'lgan $p \times p$ va $q \times q$ - matritsiyalar $F(t, x, y, \varepsilon)$, $\Phi(t, x, y, \varepsilon)$ – p va q o'lchovlarga ega $t \in R = (-\infty; +\infty)$ ε - musbat kichik parametrga ega va t bo'yicha T- davrli uzluksiz vektorlar.

$\varepsilon \to 0$ da (2.2.1) sistemaning T – davrli $x(t, \varepsilon)$, $y(t, \varepsilon)$ uzluksiz bo'lgan yechim haqidagi savolga javob beramiz.

Faraz qilaylik $A = diag(A_1, \ldots . A_s)$, $B = diag(B_1, \ldots . B_s)$ bunda A_i, B_j – $p_i \times p_j$ va $q_i \times q_j$ – matritsalar

Bunda

$$\sum_{i=1}^{r} p_i = p, \quad \sum_{j=1}^{s} q_j = q, \text{va } \mu - \text{cheksiz kichik musbat sondir}$$

Quyidagi shartlar bajarilsin

1) $|a_i| < 1 < |b_j|$, $i = 1, \ldots, s$, $j = 1, \ldots, S$;

2) $F(t, x, y, \varepsilon)$, $\Phi(t, x, y, \varepsilon)$ vektor funksiyalar $t \in R, x \in R^p$, $0 \le \varepsilon \le \varepsilon_0$, $y \in R^q$ da uzluksiz, $T - t$ da davriy va Lipshits shartini qanoatlantiradi.

$$|F(t, x', y', \varepsilon') - F(t, x'', y'', \varepsilon'')| \le l(|x' - x''| + |y' - y''| + |\varepsilon' - \varepsilon''|),$$
$$(2)$$
$$|\Phi(t, x', y', \varepsilon') - \Phi(t, x'', y'', \varepsilon'')| \le l(|x' - x''| + |y' - y''| + |\varepsilon' - \varepsilon''|)$$

bunda $t \in R$, $x', x'' \in R^p$, $y', y'' \in R^q$, $\varepsilon', \varepsilon'' \in [0, \varepsilon_0]$, l – cheksiz kichik miqdor va

$$|x| = \max_{1 \le i \le p} |x_i|, \quad |y| = \max_{1 \le j \le q} |y_j|,$$

Boshida berilgan ayirmali tenglamalar sistemasini qaraymiz

Bu sistema $\varepsilon = 0$ bo'lganda (2.2.1) dan kelib chiqadi. Kiritilgan xulosalarga ko'ra (2.2.3) sistema uchun (2.1.1) teorema o'rinlidir, yani yetarlicha kichik μ va l uchun T-davrli $(v(t), w(t))$ uzluksiz bo'lgan yagona yechim mavjuddir
Endi (2.2.1) da

$$x(t) = \breve{x}(t) + v(t), \quad y(t) = \breve{y}(t) + w(t), \tag{3}$$

Almashtirish bajarsak

$$\breve{F}(t, \breve{x}(t), \breve{y}(t), \varepsilon) = F(t, \breve{x}(t) + v(t), \breve{y}(t) + w(t), \varepsilon) - F(t, v(t), w(t), 0),$$

$$\breve{\Phi}(t, \breve{x}(t), \breve{y}(t), \varepsilon) = \Phi(t, \breve{x}(t) + v(t), \breve{y}(t) + w(t), \varepsilon) - \Phi(t, v(t), w(t), 0).$$

Osonlikda tekshirish mumkinki $F(t, \breve{x}, \breve{y}, \varepsilon)$ va $\breve{\Phi}(t, \breve{x}, \breve{y}, \varepsilon)$ vektor-funksiyalar (2) ni qanoatlantiruvchi bo'lib va $t \in R$ lar uchun quyidagi tengsizliklar o'rinlidir

$$\left|\breve{F}(t, 0,0, \varepsilon)\right| \le l\varepsilon, \qquad \left|\breve{\Phi}(t, 0,0, \varepsilon)\right| \le l\varepsilon \tag{6}$$

Shunday qilib (3) almashtirish yordamida T-davrli (1) sistemaning yechimi mavjudligi shunga o'xshash bo'lgan masala yechimga kelar ekan, bunda $F(t, \breve{x}, \breve{y}, \varepsilon)$ $\breve{\Phi}(t, \breve{x}, \breve{y}, \varepsilon)$ vektor – funksiyalar (2) va (6) shartlarni qanoatlantirishi kerak.

Teorema 1.

1), 2) shartlar bajarilsin. Bu holda

$$\lim_{\varepsilon \to 0} |\breve{v}(t, \varepsilon)| = 0,$$
$$\lim_{\varepsilon \to 0} |\breve{w}(t, \varepsilon)| = 0, \tag{7}$$

(2.2.5) da

$$\breve{x}(t) = \breve{\breve{x}}(t) + \breve{v}(t, \varepsilon), \quad \breve{y}(t) = \breve{\breve{y}}(t) + \breve{w}(t, \varepsilon),$$

almashtirish bajarsak quyidagi tenglamalar sistemasini hosil qilamiz.

$$\breve{\breve{x}}(t+1) = A\breve{\breve{x}}(t) + \breve{F}\big(t, \breve{\breve{x}}(t) + \breve{v}(t), \breve{\breve{y}}(t) + \breve{w}(t, \varepsilon), \varepsilon\big) - \breve{F}(t, \breve{v}(t, \varepsilon), \breve{w}(t, \varepsilon), \varepsilon)$$

(2.2.12)

$$\breve{\breve{y}}(t+1) = B\breve{\breve{y}}(t) + \breve{\Phi}\big(t, \breve{\breve{x}}(t) + \breve{v}(t), \breve{\breve{y}}(t) + \breve{w}(t, \varepsilon), \varepsilon\big) - \breve{\Phi}(t, \breve{v}(t, \varepsilon), \breve{w}(t, \varepsilon), \varepsilon)$$

Adabiyotlar ro'yxati

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