VARIASION TENGSIZLIKLAR ASOSIDA DINAMIK SISTEMALARNING KIRISH TA'SIRLARINI TIKLASH ALGORITMLARI

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ABSTRACT

Ushbu maqolada G'alayonlar sohasini hisob-kitob qilishda mos kelmaslik prinsipidan muntazamlashtirish parametrini tanlash va operatorli muntazamlashtirish uslubining o'xshashligi haqidagi masalani ko'rib chiqamiz,

Ushbu maqolada G'alayonlar sohasini hisob-kitob qilishda mos kelmaslik prinsipidan muntazamlashtirish parametrini tanlash va operatorli muntazamlashtirish uslubining o'xshashligi haqidagi masalani ko'rib chiqamiz, matrisaga nisbatan rekurrent tenglamalar sistemasini ko'rib chiqamiz:

$$\left(\delta^2 I_m + \tilde{F}^T\tilde{F} - \lambda_* D\right)\theta = \tilde{F}^T\tilde{y}^*, \qquad \delta > 0. \qquad (1.1)$$

(2.2) dagi F operatorlar barcha $\delta \ge 0$ da quyidagi xususiyatga ega bo'ladi deb faraz qilamiz:

$$\left\|F\theta - y_\delta^*\right\| \le c_1\left(\left\|\theta - \theta^0\right\| + 1\right), \ \forall\theta \in T, \qquad (1.2)$$

bu yerda: $c_1 > 0$ –ayrim o'zgarmaslar, θ^0 – H dan belgilangan nuqta.

θ ning yechimini hisoblash uchun muntazamlashtirishning operator uslubidan foydalanamiz:

$$\left(F\theta + \alpha\left(\theta - \theta^0\right) - y_\delta^*,\ z - \theta\right) \ge 0, \ \forall z \in K_\sigma,\ \theta \in K_\sigma, \qquad (1.3)$$

bu yerda: $\alpha > 0$.

θ_γ –(1.3) ning yagona yechimi bo'lsin; bu yerda $\gamma = (\delta, \sigma, \alpha)$. Demak, shunday $F\theta_\gamma$ element topilsinki, quyidagi munosabat haqiqiy bo'lsin

$$\left(F\theta_\gamma + \alpha\left(\theta_\gamma - \theta^0\right) - y_\delta^*,\ z - \theta_\gamma\right) \ge 0, \quad \forall z \in K_\sigma. \qquad (1.4)$$

U holda, (1.2) va (1.4) asosida quyidagicha yozish mumkin

$$\alpha\left(\theta_\gamma - \theta^0, \theta_\gamma - \upsilon_\gamma\right) \le \left(F\theta - y^*, u_\gamma - \theta_\gamma\right) + \left(F\theta_\gamma - y_\delta^*, \upsilon_\gamma - \theta\right) + \delta\left\|\theta - \theta_\gamma\right\|, \qquad (1.5)$$

bu yerda $\theta \in N$ va barcha $z \in K$, $u_\gamma \in K$, $\upsilon_\gamma \in K_\sigma$ da $\left(F\theta - y^*, z-\theta\right) \geq 0$ tengsizlik bajariladi, shu bilan birga $\left\|\theta_\gamma - u_\gamma\right\| \leq \sigma$, $\left\|\theta - \upsilon_\gamma\right\| \leq \sigma$.

Keyin, (1.2) va (1.5) dan kelib chiqib quyidagiga ega bo‘lamiz:

$$\left\|\theta_\gamma - \theta^0\right\| \leq \delta/\alpha + c_1\sigma/\alpha + 2\left\|\theta - \theta^0\right\| + 2 + \sigma.$$

Agar ko‘rib chiqilayotgan shartda $\alpha \to 0$ da δ/α, $\sigma/\alpha \to 0$ bo‘lsa, u holda $\{\theta_\gamma\}$ ketma-ketlik $\alpha \to 0$ da quyidagi tenglik

$$\left\|\theta^* - \theta^0\right\| = \min_{\theta \in N}\left\|\theta - \theta^0\right\|.$$

bilan aniqlanuvchi $\theta^* \in N$ element H ga kuchli yaqinlashishiniko‘rsatish mumkin.

Yuqorida K va K_σ to‘plam $r(K, K_\sigma) \leq \sigma$ shartini qanoatlantiradi, ushbu to‘plamlar ayrim ma’noda “teng” yaqinlikka mos keladi, deb faraz qilindi. Biroq masalaning keng doirasi uchun ushbu shart bajarilmaydi. Masalan, agar, K R_2 da – cheklangan to‘plam va cheklov $y = ax + b$ chiziqli funksiya bilan berilsa, u holda a koyeffisiyentidagi har qanday yetarli kichik xatoda $r(K, K_\sigma) = \infty$ bo‘ladi. Shuni ta’kidlash kerakki, K cheklangan to‘plamda $r(K, K_\sigma) \leq \sigma$ sharti tabiiy hisoblanadi.

K to‘plam chegaralanmagan deb hisoblansin, R ni juda katta deb olsak, K_σ^R va $N \cap K^R = M^R$ bo‘sh bo‘lmasligi mumkin. $r(K^R, K_\sigma^R) \leq \sigma$ deb faraz qilamiz. Qo‘yilgan masalani K^R (R belgilangan) da muhokama qilib, $\bar{\theta}^* \in N_R$ elementiga muntazamlashtirilgan yechimni olamiz, bu yerda N_R - quyidagi

$$\left(F\theta - y^*, z-\theta\right) \geq 0 \;\; \forall z \in K^R, \theta \in K^R, \tag{1.6}$$

tengliksizlik yechiminingto‘plami, shu bilan birga

$$\left\|\bar{\theta}^* - \theta^0\right\| = \min_{\theta \in N_R}\left\|\theta - \theta^0\right\|.$$

N_R va M^R to‘plami qavariq [77, 78], u holda $\theta \in N_R \setminus M^R$ va $\theta \in \partial K^R$ mavjud bo‘lsa, $\bar{\theta} \in N_R \setminus M^R$, $\bar{\theta} \in \operatorname{int} K^R$ ham topiladi. Shubhasiz, $N_R = M^R$.Demak, (1) ni o‘rniga (1.6) ifodadan foydalanish mumkin va unga muntazamlashtirishni qo‘llab, $\theta^* \in N$ topish kerak.

θ_α - quyidagi tengsizlikning yagona yechimi deb faraz qilamiz,

$$\left(F\theta + \alpha\left(\theta - \theta^0\right) - y^*, z-\theta\right) \geq 0, \; \forall z \in K. \tag{1.7}$$

Demak

$$\left(F\theta_\alpha + \alpha\left(\theta_\alpha - \theta^0\right) - y^*, z-\theta_\alpha\right) \geq 0, \; \forall z \in K.$$

$z = \theta^0$ bo‘lganda oxirgi tengliksizlikdan

$\left(F\theta_\alpha - y^*, \theta_\alpha - \theta^0\right) + \alpha\left\|\theta_\alpha - \theta^0\right\|^2 \leq 0$ olish mumkin,ya’ni $\left(F\theta_\alpha - y^*, \theta_\alpha - \theta^0\right) \leq 0$,

bu holda $\theta_{t+1}^\delta = \theta_t^\delta + \dfrac{\gamma_k^\delta(t)\theta_t^\delta(k)}{\delta^2/\lambda_* - p_{kk}^\delta(t)}$ dan $\{\theta_\mu\} \subset \{\theta_\alpha\}$, $\theta_\mu \to \bar{\theta}$ ketma-ketligining mavjudligi kelib chiqadigan quyidagi ifodaga ega bo‘lamiz :

$$\left\|\theta_\alpha - \theta^0\right\| \leq R, \tag{1.8}$$

Ko'rib chiqilgan shartlarda (1.7) ifoda $\left(F\theta+\alpha\left(z-\theta^{0}\right)-y^{*}, z-\theta_{\alpha}\right)\geq 0$ tengsizlikka ekvivalentdir. Oxirgi nisbatga $\alpha=\mu$ ni qo'yib va $\mu\to 0$ ga o'tib, $\left(F\theta-y^{*}, z-\bar{\theta}\right)\geq 0$ ni, ya'ni $\bar{\theta}$ - yechimni olamiz. Bundan tashqari, (1.8) dan quyidagi kelib chiqadi: $\left\|\bar{\theta}-\theta^{0}\right\|\leq R$.

Ko'pincha K va K_{σ} to'plamlarning yaqinligi quyidagi ifoda asosida aniqlanadi [3, 4]:
$S(R,K,K_{\sigma})=\sup\limits_{\upsilon\in K^{R}}\inf\limits_{u\in K_{\sigma}}\|u-\upsilon\|$, $\forall R\geq 0$.

Shu bilan birga, agar K^{R} bo'sh bo'lsa, u holda hech bo'lmaganda K_{σ}^{R} yoki K^{R} to'plamlaridan biri bo'sh bo'lmasa, $S(R,K,K_{\sigma})=0$ hisoblanadi, u holda $\tau(R,K,K_{\sigma})=\max\left\{S(R,K,K_{\sigma}),S(R,K_{\sigma},K)\right\}$ ekanligi ko'rib chiqiladi.

$\tau(R,K,K_{\sigma})\leq a(R)\sigma$, bu yerda $R\to\infty$

$$\left(F\theta+\alpha E^{a}\left(\theta-\theta^{0}\right)-y_{\delta}^{*}, z-\theta\right)\geq 0,\ \forall z\in K_{\sigma},\ \theta\in K_{\sigma}, \qquad (1.9)$$

bo'lganda $a(R)$ $(R\geq 0)$, $a(R)\to\infty$ bo'lishinitaklif qilamiz. Bu yerda $\theta\neq 0$ va $E^{a}(0)=0$ bo'lganda $E^{a}:H\to H, E^{a}(\theta)=a(\|\theta\|)\theta/\|\theta\|$ bo'ladi.

Avvalgidek (1.9) ning yechimini θ_{γ} orqali belgilaymiz.

(1.5) ga o'xshash, quyidagicha yozish mumkin:

$$a\left(\left\|\theta_{\gamma}-\theta^{0}\right\|\right)\left[\left\|\theta_{\gamma}-\theta^{0}\right\|-c_{2}-c_{1}\left(\left\|\theta-\theta^{0}\right\|+1\right)\frac{\sigma}{\alpha}\right]-$$
$$-\left\|\theta_{\gamma}-\theta^{0}\right\|\left[\frac{\delta}{\alpha}+c_{1}a\left(\left\|\theta-\theta^{0}\right\|\right)\frac{\sigma}{\alpha}\right]-\frac{\delta}{\alpha}\left\|\theta-\theta^{0}\right\|+c_{1}a\left(\left\|\theta-\theta^{0}\right\|\frac{\sigma}{\alpha}\right)\leq 0, \qquad (1.10)$$

bu yerda: $c_{2}=\left\|\theta-\theta^{0}\right\|+a\left(\left\|\theta-\theta^{0}\right\|\right)\sigma$.

$\alpha\to 0$ da δ/α, $\sigma/\alpha\to 0$ bo'lsin, u holda (2.17) ifodadan ko'rinib turibdiki, $\left\|\theta_{\gamma}\right\|\leq C$ va γ ga bog'liq bo'lmagano'zgarmas C mavjud.

Shunday qilib, agar $\alpha\to 0$ da δ/α, $\sigma/\alpha\to 0$ bo'lsa, u holda $\left\{\theta_{\gamma}\right\}$ ketma-ketlik $\theta^{*}\in N$ elementga kuchli yaqinlashadi.

Xulosa

Olingan ifodalar muntazamlashtirishning operator uslubidan foydalanib variasion tengliksizliklar asosida izlanayotgan yechimlar o'xshashligini ta'minlashga imkon beradi.

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