KVADRATIK STOXASTIK OPERATORLARNING YANA BIR TADBIQI HAQIDA

Mamurov Boboxon Jo'rayevich,
Buxoro davlat universiteti
«Matematik analiz» kafedrasi dotsenti
Ro`ziyev Adham,
Buxoro davlat universiteti 2-bosqich talabasi

Annotatsiya: Bu maqolada kvadratik stoxaxastik operatoplarning yana bir tatbiqi,statistik mexanikadagi Boltsman modeliga tadbiqi qaraladi. Bu model ham kvadratik stoxostik operator orqali tasvirlab beriigan. Mazkur modeldan statistik mexanika va kvadratik stoxastik operatorlar nazariyasidan o`qiladigan ma`ruzalarda ularning tadbiqlari sifatida ham foydalanish mumkin.

Kalit so`zlar: Gaz,molekula, Boltsman modeli, kvadratik stoxostik operator. About another application of quadratic stochastic operators

ABOUT ANOTHER APPLICATION OF QUADRATIC STOCHASTIC OPERATORS

Mamurov Bobokhon Jurayevich
Associate Professor of the Department
of Mathematical Analysis, Bukhara State University
Roziyev Adham
2nd year student of Bukhara State University

Annotation: This article considers another application of quadratic stochastic operatops, its application to the Boltzmann model in statistical mechanics. This model is also described by a quadratic stochastic operator. This model can be used as their application in lectures on the theory of statistical mechanics and quadratic stochastic operators.

Keywords: Gas, molecule, Boltzmann model, quadratic stochastic operator.

Kvadratik operatorlar biologiya, ximiya, mexanikaning ba'zi modellarini o'rganishda muhim rol o'ynaydi.

E={1,2, .. . ,n} bo`lsin.

1-ta`rif. $S^{n-1}$= { x=($x_1$, . . .,$x_n$)∈ $R^n$ : $x_i$ ≥0, $\sum_{i=1}^{n} x_i$ =1} to`plamga (n-1) o`lchamli simpleks deb aytiladi.

Bunda har bir x∈ S^{n-1} element E to`plamda ehtimollik o`lchovi bo`lib, uni n ta elementdan iborat qandaydir biologik(fizik) tizim kabi talqin qilish mumkin.

2-ta`rif. Kvadratik stoxastik operator deb, V: $S^{n-1} \to S^{n-1}$

$$V : x'_k = \sum_{i,j=1}^{n} p_{ij,k}\, x_i x_j,$$

ko`rinishdagi operatorga aytiladi, bunda

$p_{ij,k} \geq 0$, $p_{ij,k} = p_{ji,k}$, $\sum_{k=1}^{n} p_{ij,k} = 1$.

Biz bu maqolada kvadratik stoxastik operatorlarning statistik mexanikaga tatbiqlaridan birini qarab chiqamiz.

Masalan, statistik mexanikadagi Boltsman modelini ham kvadratik stoxostik operatorlar orqali tasvirlab berish mumkin.

Qattiq mutlaqo elastik devorlar orasiga o'ralgan gazni qaraymiz, uning molekulalari radiuslari va massalari bir xil bo'lgan qat'iy absolyut elastik sharlardan iborat bo'lsin. Molekulalarning tezlik vektorlari to'plamini R^3 ning elementlari sifatida qaraymiz.

R^3 ni n ta $E_1, E_2, \dots, E_n$ sohalarga shunday bo'lamizki, $E_i \cap E_j = \emptyset$ $(i \neq j)$ va $\bigcup_{i=1}^{n} E_i = R^3$ bo`lsin.

$i = 1,2,\dots,n$ lar uchun

$$x_i(t) = \left\{ \begin{matrix} t\ momentda\ tezligi\ E_i\ sohada \\ yotadigan\ molekulalarning\ ulushi \end{matrix} \right\}$$

deb belgilab olamiz.

Bir qator tabiiy fizik farazlarda

$$\left\{ \begin{matrix} birlik\ vaqt\ oralig'ida \\ l - m\ to'qnashuvlar \\ soni \end{matrix} \right\} = \mu_{lm}\, x_l\, x_m, \qquad \mu_{lm} > 0.$$

p_{lm}^{i}bilan E_l dagi molekulalarning E_m dagi molekulalar bilan to'qnashganda E_i ga tarqaladigan qismini belgilaymiz.

$\sum_{i=1}^{n} p_{lm}^{i} = 1$ bo`lishliligiga osongina ishonch hosil qilish mumkin. Bu holda

$$\left\{ \begin{matrix} \mathrm{E_l\ dagi\ molekulalarning\ birlik} \\ \mathrm{vaqt\ oralig'ida\ l - m\ to'qnashuv} \\ \mathrm{natijasida\ E_i\ ga\ tarqaladiganlari} \\ \mathrm{soni} \end{matrix} \right\} = \mathrm{p_{lm}^{i}\, \mu_{l_m}\, x_l\, x_m},$$

qaysiki,

$$\mathrm{x_i}(t+1) - x_i(t) =$$

$$\sum_{lm} p_{lm}^{i}\, \mu_{lm}\, x_l\ x_m - \sum_{lm} p_{lm}^{l}\, \mu_{im}\, x_i\ x_m =$$

$$= \sum_{l,m} a^{i}{}_{l_m}\, x_i\, x_m,$$

bu yerda $a_{lm}^{i} = \frac{1}{2}\left[\left(p_{ml}^{i} + p_{ml}^{i}\right) - \left(\delta_{il} + \delta_{im}\right)\right] \cdot \mu_{lm}$

va

δ_{ij}- Kroneker belgisi: $\delta_{ij} = \begin{cases} i = j\ bo`lsa, 1 \\ i \neq j\ bo`lsa, 0 \end{cases}$.

Oxirgi tenglikdan

$x_i(t+1) = \sum_{l,m=1}^{n} p_{ml,i}\ x_m(t)\, x_l(t),$ i=1,2, . . .,n,

bunda $p_{ml,i} = a_{lm}^{i} + \delta_{ml,i}$ va

$$\delta_{ml,i} = \left\{\begin{matrix} 1, agar\ m = l = i \\ \frac{1}{2}, agar\ m \neq l\ va\ m = i\ yoki\ l = i \\ 0,\ qolgan\ hollarda \end{matrix}\right\}.$$

Qilingan farazlar va belgilashlarga asoslanib, $p_{ml,i}$ koeffitsentlarning quyidagi shartlarni qanoatlantirishiga ishonch hosil qilish mumkin:

1) $p_{ml,i} \geq 0$;

2) $p_{ml,i} = p_{lm,i}$;

3) $\sum_{i=1}^{n} p_{ml,i} = 1.$

Yuqoridagilardan ko`rinadiki, statistik mexanikadagi Boltsman modelini kvadratik stoxostik operatorlar orqali ta`riflash mumkin ekan.

Biz [1] da populyatsiya evolyutsiyasini tasodifiy jarayon deb qarab,autsom populyatsiyaning ozod populyatsiya holida populyatsiyaning evolyutsion operatopi kvadratik akslantirish bo`lishiga ishonch hosil qilgan edik. Shuni ta`kidlash lozimki, [1-7] va [8-13] larda qaralgan biologik va tibbiy modellarda vaqt diskret edi. Bu maqolada qaralgan statistik mexanikadagi Boltsman modelida esa vaqt uzluksiz bo`ladi.

XULOSA

Yuqorida hamda [1-13] maqolalarda kvadratik va kubik stoxastik operatorlarga doir nazariy masalalar va ular orqali ta`riflash mumkin bo`lgan turli modellar o`rganilgan. Keltirilgan modellardan statistik mexanika, biologiya,differentsal tenglamalar va kvadratik stoxactik operatorlar nazariyasidan o`qiladigan ma`ruzalarda, ularning tadbiqlari sifatida foydalanish mumkin. Bu esa, o`tilgan nazariy materialni chuqurroq tushunush imkonini beradi.

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