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МАТЕМАТИКА, ФИЗИКА ВА АХБОРОТ ТЕХНОЛОГИЯЛАРИНИНГ ДОЛЗАРБ МУАММОЛАРИ

МАВЗУСИДАГИ РЕСПУБЛИКА МИҚЁСИДАГИ ОНЛАЙН ИЛМИЙ-АМАЛИЙ АНЖУМАНИ

ТЕЗИСЛАР ТЎПЛАМИ

ЎЗБЕКИСТОН РЕСПУБЛИКАСИ ОЛИЙ ВА
ЎРТА МАХСУС ТАЪЛИМ ВАЗИРЛИГИ

БУХОРО ДАВЛАТ УНИВЕРСИТЕТИ

ФИЗИКА-МАТЕМАТИКА ФАКУЛЬТЕТИ

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Республика миқёсидаги онлайн илмий-амалий анжумани

ТЕЗИСЛАР ТЎПЛАМИ

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DYNAMICAL SYSTEM OF QUADRATIC STOCHASTIC OPERATOR WITH VARIABLE COEFFICIENTS

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In this work we use theory of dynamical systems (see [1], [2]) learn the dynamics of quadratic stochastic operator with variable coefficients, that is mapping S^1into itself. Consider a population of 2 species. For a variable coefficient $p(x)$ define an evolution operator $V_{a,b,c}: z = (x, y) \in S^1 \to z' = (x', y') \in S^1$as following:

$$V_{a,b,c}: \begin{cases} x' = x^2 + 2p(x)xy \\ y' = 2(1 - p(x))xy + y^2 \end{cases}$$

where $$p(x) = \begin{cases} a, \text{ if } x \le \frac{1}{3} \\ b, \text{ if } \frac{1}{3} < x < \frac{2}{3} \\ c, \text{ if } x \ge \frac{2}{3} \end{cases}$$

Consider the dynamical system generated by the evolution operator $V_{a,b,c}$. Using $x + y = 1$ the operator can be reduced to the following mapping $f_{a,b,c}: [0,1] \to [0,1]$:

$$f_{a,b,c}(x) = \begin{cases} (1-2a)x^2 + 2ax, & \text{if } x \le \frac{1}{3} \\ (1-2b)x^2 + 2bx, & \text{if } \frac{1}{3} < x < \frac{2}{3} \\ (1-2c)x^2 + 2cx, & \text{if } x \ge \frac{2}{3} \end{cases}$$

Assume that $a = b = c$, then $f_{a,b,c}(x) = (1-2a)x^2 + 2ax$, $x \in [0,1]$. To find the set of fixed points of this function, we solve following equation: $(1-2a)x^2 + 2ax = x$. The solutions of the equation are: $x_1 = 0, x_2 = 1$ and if $a = 1\backslash 2$ then $Fix(f) = [0,1]$.

Theorem. 1. The point 0 is attractor for $f_{a,b,c}(x)$, if a belongs $[0, \frac{1}{2}]$, and repeller if a belongs $(\frac{1}{2}, 1]$.

2. The point 1 is repeller for $f_{a,b,c}(x)$, if c belongs $[0, \frac{1}{2}]$, and attractor if $c \in (\frac{1}{2}, 1]$.

References:

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2. R.N. Ganikhodzhaev, F.M. Mukhamedov, U.A. Rozikov, Quadratic stochastic operators and processes: results and open problems, Inf. Dim. Anal. Quant. Prob. Rel. Fields.

ON CLASSIFICATION OF SINGULARITIES OF PHASE FUNCTION AND RELATED OSCILLATORY INTEGRALS

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In this work we consider estimates for order of amplitude function of convolution kernel. The convolution operator is considered in the paper appear in the Cauchy problem for strongly hyperbolic equations. We give solutions of some problems posed by M.Sugimoto. Our results are based on estimates for oscillatory integrals with phase having A type singularities.

Let $\varphi \in C^{\omega}(R^n \backslash 0)$ be a real analytic on $R^n \backslash 0$ and homogeneous of order 1. $a_k(\xi) \in C^{\infty}(R^n)$ is homogeneous of order $-k$ for large $|\xi|$. Consider the convolution operator given by the kernel.

$$K_k(x) = F^{-1}\left(e^{i\varphi(\xi)} a_k(\xi)\right). \tag{1}$$

Following [1] we can localize the $a_k(\xi)$ in a sufficiently small conic neighborhood of a fixed point $v \in S^2$ where S^2 is a unite sphere centered at the origin of R^3. Without loss of generality we may assume that $v = (0,0,1)$ and

$$\frac{\partial}{\partial \xi_1}\varphi(0,0) = \frac{\partial}{\partial \xi_2}\varphi(0,0) = 0$$

$$\varphi(0,0,1) = 0 \quad \frac{\partial}{\partial \xi_1}\varphi(0,0,1) \neq 0$$

Otherwise, we may use linear change of variables

$$\xi_1 = \eta_1, \xi_2 = \eta_2, \xi_3 = \eta_3 - \frac{\partial \varphi(0,0,1)}{\partial \xi_2}\eta_2 - \frac{\partial \varphi(0,0,1)}{\partial \xi_1}\eta_1.$$

Then for the function

$$\varphi_1(\eta_1,\eta_2,\eta_3) = \varphi\left(\eta_1,\eta_2,\eta_3 - \frac{\partial \varphi(0,0,1)}{\partial \xi_2}\eta_2 - \frac{\partial \varphi(0,0,1)}{\partial \xi_1}\eta_1\right)$$

We have $\varphi(0,0,1) = 1$

$$\frac{\partial \varphi_1(0,0,1)}{\partial \eta_1} = \frac{\partial \varphi_1(0,0,1)}{\partial \eta_2} = 0 \quad \frac{\partial \varphi(0,0,1)}{\partial \eta_3} = 1$$

We remind classification for the function given by M.Sugimoto [2]. We assume

$h(0,0) \neq 0, \quad \xi_1 = 1 + h(\xi_1,\xi_2), \ \nabla h(0,0) = 0$

Then we define the function $b_0(y_2)$ and $b_1(y_2)$, which are real analytic at the origin, by the equations

$$h'_1(b_1(y_2),y_2) = 0, \ \ b_1(0) = 0, \ \ b_0(y_2) = h(b_1(y_2),y_2).$$

They are uniquely determined near the origin by the implicit function theorem. The curve $(b_1(t), t, b_0(t))$ is the ridge of the mountain $\sum$ when we see it parallel to the y_1-axis.

Definition. Let $h(y) = h(y_1,y_2)$ be a real analytic function at the origin satisfying (2.13), and $b_j(y_2)$ be defined by (2.14) $(j - 0,1)$. Then we define δ_j to be the smallest integer $m \geq 2$ such that $b_j^{(m)}(0) \neq 0$, and we say that $h(y)$ is of type I if $\delta_0 < \infty$, type II if $\delta_0 = \infty, \delta_1 < \infty$ and type III if $\delta_0 = \delta_1 = \infty$.

The following result holds true.

Proposition. The function h is of type I if and only if when h has singularity of type $A_{\delta_0 - 1}$ at the origin. The function h is of type II or III if and only if h has A_∞ type singularity at the origin.

References

1. Sugimoto M., A priori estimates for higher order hyperbolic equations, Math. Z. 215, pp. 519-531, 1994.
2. Sugimoto M., Estimates for hyperbolic equations of space dimension 3, Journal of functional analysis 160, pp.382-407, 1998.

THE NUMERICAL RANGE OF FRIEDRICHS MODEL WITH RANK TWO PERTURBATION

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Let L be a complex Hilbert space with inner product $(\cdot;\cdot)$ and H be a linear operator in L with domain $D(H) \subset L$. Then the numerical range of an L is the subset of the complex numbers C, given by

$$W(H) := \{(Hx, x) : x \in D(H), \ \|x\| = 1\}.$$

It was first studied by O.Toeplitz in [1]. In [2] F.Hausdorff showed that indeed the set $W(H)$ is convex. Then the notion of numerical range is generalized by the different ways, see for example [3-5].

For positive integer number d let T^d be the d-dimensional torus, the cube $(-\pi,\pi]^d$ with appropriately identified sides equipped with its Haar measure and $L_2(T^d)$ be the Hilbert space of square integrable (complex) functions defined on T^d.

Let us consider a so-called Friedrichs model H acting on the Hilbert space $L_2(T^d)$

$$H := H_0 - \mu_1 V_1 + \mu_2 V_2, \qquad (1)$$

where the operators H_0 and V_α, $\alpha = 1,2$ are defined by

$$(H_0 f)(p) = u(p) f(p), \quad (V_\alpha f)(p) = \mu_\alpha \upsilon_\alpha(p) \int_{T^d} \upsilon_\alpha(t) f(t) dt, \quad \alpha = 1,2.$$

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