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FUNCTIONAL SPACES

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ANNOTATION.

In the article classic methods , different in appearance heat spread equation , functional to spaces circle concepts , a priori evaluation for necessary has been inequalities and theorems studied.

Keywords: : Lebesgue space, Sobolev space, Golder's inequality, Jung's inequality, Poincaré-Friedrichs inequality, A priori estimates

ENTER

AV Bitsadze and AA Samarsky were the first to propose and study these problems for elliptic equations. Later these problems were called Bitsadze-Samarsky problems. In recent decades, nonlocal problems for differential equations have been actively studied by many mathematicians. To date, local boundary and nonlocal problems for classical equations of mathematical physics have been well studied using classical methods. But these issues are not well studied in Sobolev spaces by modern (functional) methods in the theory of generalized functions.

Functional spaces about briefly data .

$L_2(Q)$ - **Lebesgue space.**

a Lebesgue space $L_1[a,b]$ as a Banach space formed by the complement of a normed space. Here, $L_1[a,b]$ the elements of the normed space $[a,b]$ are continuous functions defined on the interval, where is $x(t)$ the norm of the function

$\|x(t)\| = \int_a^b |x(t)|\,dt$ equality through determined will be $[a,b]$ in between determined $\{x_n(t)\}$ and $\{x_n^*(t)\}$ continuously functions sequences given let it be If $\{x_n(t) - x_n^*(t)\}$ succession $L_1[a,b]$ normalized in space infinite small if , that is $n \to \infty$ at

$$\|x_n(t) - x_n^*(t)\| = \int_a^b |x_n(t) - x_n^*(t)|\,dt \to 0$$

if , then $\{x_n(t)\}$ and $\{x_n^*(t)\}$ continuously functions sequences $L_1[a,b]$ normalized in space equivalent or average in a sense is said to be equivalent .

If optional $\varepsilon > 0$ for a positive number so one $N = N(\varepsilon)$ no there is is optional $n \geq N$ for and optional $p \in N$ natural number for

$$\|x_{n+p} - x_n\| = \int_a^b |x_{n+p}(t) - x_n(t)|\,dt < \varepsilon ,$$

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inequality appropriate if , then $[a,b]$in between determined $\{x_n(t)\}$ and $\{x_n^*(t)\}$ continuously functions sequences are fundamental or average it is said to be fundamental in the meaning .

Filling about to the theorem basically $L[a,b]$ Lebesgue space average in a sense equivalent and average was fundamental in meaning continuously functions of succession from the class consists of has been $\widehat{x}$ of the elements Created will be

Average was fundamental in meaning $[a,b]$in between determined $\{x_n(t)\}$ continuously functions sequences one $\widehat{x}(t)$ from class to be for their average in a sense equivalent to be necessary and is enough . If $\{x_n(t)\} \in \widehat{x}(t)$ if , then definition according to

$$\|\widehat{x}\|_{L[a,b]} = \lim_{n\to\infty}\int_a^b |x_n(t)|\,dt = \lim_{n\to\infty}\|x_n(t)\|_{L_1[a,b]} \qquad (1.3.1)$$

equality with is determined .

From this except (1) expression $|\widehat{x}(t)|$ from the function received Lebesgue we call it an integral , in which $\widehat{x}(t) \in L[a,b]$ will be To the description according to , expression (1.3.1).

$$\int_a^b |\widehat{x}(t)|\,dt = \lim_{n\to\infty}\int_a^b |x_n(t)|\,dt$$

in the form of is , where is the left-hand side Lebesgue integral , right on the side while Riemann is integral .

1.2.2 - $L_p(G),\quad p\geq 1$ **Lebesgue space** Previous in point considered space one little more general has been become transfer let's look . G collection R^n in space limited field let it be $\overline{G}$ while that's it G of the field cover let it be $L_p(G),\quad p\geq 1$ Lebesgue space $L_p(\overline{G}),\quad p\geq 1$ linear normalized of space filler as is determined .

$L_p(G),\quad p\geq 1$ Lebesgue of space elements $L[a,b]$ Lebesgue as in space as some " functions " . to him $\overline{G}$ closed in the field determined continuously functions with average approach in the sense of desired in accuracy zoom in possible will $L_p(\overline{G}),\quad p\geq 1$be linear normalized space $L_p(G),\quad p\geq 1$ Lebesgue in space dense will be

If $n,m\to\infty$ $\overline{G}$ closed in the collection determined $\{u_n(x)\}$ continuously functions sequence for

$$\|u_n - u_m\|^p_{L_p(\overline{G})} = \int_G |u_n(x) - u_m(x)|^p\,dx \to 0$$

if , then $\overline{G}$ closed in the collection determined $\{u_n(x)\}$ continuously functions sequence $L_p(\overline{G}),\quad p\geq 1$ linear normalized fundamental in space or $p-$ level average it is said to be fundamental in the meaning .

If $\{u_n(x) - u_n^*(x)\}$ succession $L_p(\overline{G}),\quad p\geq 1$ normalized in space infinite small if , that is, in n $n\to\infty$

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$$\|u_n(x)-u_n^*(x)\|_{L_p(\bar{G})}^p = \int_G |u_n(x)-u_n^*(x)|^p\, dx \to 0$$

if , then $\{u_n(x)\}$ and $\{u_n^*(x)\}$ continuously functions sequences $L_p(\bar{G}),\quad p\geq 1$ normalized in space equivalent or $p-$level average in a sense is said to be equivalent . It's both even $\bar{G}$ without closed collection according to received n– times Riemann integral mean caught

Sobolev space

General definition R^m in space $\bar{G}$ closed limited field given let it be That's it $\bar{G}$ closed limited in the field l times continuously differentiable $u:\bar{G}\to R^1$ (simplicity for real of value) was $u(x)$ of functions linear space let's look . $\bar{G}$ closed limited in the field differentiability each different in a sense to understand can We are $u(x)$ a function G in the field l times continuously differentiable and each one private derivative G from the field received x point that's it G of the field at the border optional to the point when striving finite to the limit have We think that it will be . As a result his each one private of the derivative $\bar{G}$ to the field continuation that's it $\bar{G}$ closed limited in the field continuously has been from the function consists of will be This is us on the ground G of the field Γ the limit enough we consider smooth . From this except , usually G field one related and another addition conditions satisfaction some cases Demand we will This is under review linear in space the norm concept $p\geq 1$ for $\|u\| = \{\int_G |u(x)|^p\, dx + \sum_{1\leq|a|\leq l}\int_G |D^a u(x)|^p\, dx\}$ we introduce with equality. We denote by the normed space formed by which all axioms of the norm are valid, $W_p^l(\bar{G})$ and it is called the Sobolev space.

$W_2^2(Q)$ - Sobolev in space scalar multiplication and the norm as follows we define :

$$(u,v)_2^2 = \int_Q (uv + u_x v_x + u_t v_t + u_{tt}v_{tt} + u_{xt}v_{xt} + u_{xx}v_{xx})dxdt$$

$$\|u\|_2^2 = \int_Q (u^2 + u_t^2 + u_x^2 + u_{xx}^2 + u_{xt}^2 + u_{tt}^2)dxdt,$$

In particular $W_2^0(Q) = L_2(Q)$:

$L_p(Q), (1 \leq p < \infty)$ through Lebesgue in the sense of integrable functions space banah space let's define

$W_p^m(Q)$ orca elements $L_p(Q)$, in space identified m - according to what order generalized r sources there is has been functions - Sobolev space we define ;$C^0(Q) = C(Q)$, through Q in the field continuously has been functions space let's define and the norm as follows let's find out $\|u\|_{C(Q)} = \sup_{(x,t)\in Q} |u(x,t)|$.

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$C^l(Q)$ $(l = 0,1,2,\ldots)$ through Q in the field l in order derivatives continuously has been functions space let's define and the norm as follows let's find out

$$\|u\|_{C^l(Q)} = \|u\|_{C(Q)} + \sum_{|k|\le l} \|D^{(k)}u\|_{C(Q)}.$$

A priori grades in getting each different from inequalities we use ;

Jung's inequality :

$$\forall u,v \in \mathbb{R}, \forall s > 0,\ p,q > 1, \quad |u \cdot v| \le \frac{s^p u^p}{p} + \frac{v^q}{qs^q},\ \frac{1}{p} + \frac{1}{q} = 1 \text{ at}$$

Try it s **inequality :** (Young's inequality private free $p = q = 2$)

$$\forall u,v \in \mathbb{R}, \forall s > 0, \quad |u \cdot v| \le \frac{s u^2}{2} + \frac{v^2}{2s}$$ [120] ,[121],[171];

Poincaré-Friedrichs inequality : [120] , [121].

Hypothesis let's do it function $u \in W_2^1(Q)$ and Dirichlet condition $u|_{\partial Q} = 0$ or $gu(x,0) = u(x,T)$, nonlocal borderline condition satisfy then , this function for Poincaré-Friedrichs inequality appropriate will be

$$\forall u \in W_2^1(Q), \quad \|u\|_0 \le c\,\|u_x\|_0, \quad c = const > 0;$$

The relations connecting the value of the solution and its derivatives at the boundary and interior points of the field are called nonlocal problems. In the theory of nonlocal boundary value problems for differential equations, there are many open and understudied problems of both theoretical and practical interest that need to be addressed. Among them, for example, we note a wide category of questions related to the uniqueness, existence and stability (stationarity) of solutions.

AV Bitsadze and AA Samarsky were the first to propose and study these problems for elliptic equations. Later these problems were called Bitsadze-Samarsky problems. In recent decades, nonlocal problems for differential equations have been actively studied by many mathematicians. To date, local boundary and nonlocal problems for classical equations of mathematical physics have been well studied using classical methods. But these issues are not well studied in Sobolev spaces by modern (functional) methods in the theory of generalized functions.

This is the article determines relevance.

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