

Email: norzad@ut.ac.ir , : , : : wwww.SID.ir

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$$\begin{array}{c} \varphi(t) \in v_{0} & () & v_{j} = \psi_{j} \oplus \psi_{j}, \\ \varphi(t) & v_{1} - \varphi(t) & \psi_{j} \oplus \psi_{j-1} \oplus \psi_{j} \\ \varphi(t) = \sum_{n} h(n) \sqrt{2} \cdot \varphi(2t - n), n \in Z & () \\ \sqrt{2} & h(n) & \lim_{j \to \infty} v_{j} = \{0, \\ () & \lim_{j \to \infty} v_{j} = \{0, \\ () & \lim_{j \to \infty} v_{j} = \{0, \\ () & \lim_{j \to \infty} v_{j} = \{0, \\ () & \dots & 1 \\ \vdots & \vdots & \vdots \\ f(t) \in v_{j} \Leftrightarrow f(t) \\ () & \vdots & \vdots \\ \psi_{k}(t) = \psi(t - k) & \psi_{0} & \vdots \\ \vdots & v_{1} & \psi_{0} & \vdots \\ \psi(t) = \sum h_{1}(n) \cdot \sqrt{2} \cdot \varphi(2t - n) & n \in Z & () \\ \vdots & v_{1} & \psi_{0} & k \\ \psi(t) = \sum h_{1}(n) \cdot \sqrt{2} \cdot \varphi(2t - n) & n \in Z & () \\ \vdots & \psi_{j} \cdot v_{j} & f(t) = \sum_{k} a_{k} \cdot \varphi_{k} \\ < \varphi_{j,k}(t) \cdot \psi_{j,k}(t) > = \int \phi_{j,k}(t) \psi_{j,k}(t) dt = 0 & v_{j} \\ j,k,l \in Z & () & h(n) \quad h_{1}(n) & v_{j} = \frac{span(\phi_{j,k}(t) - \psi_{j,k}(t))}{\psi_{j,k}(t) = 2^{j/2} \cdot \varphi(2t - k)} & () & if \quad f(t) \in v_{j} \Rightarrow J \\ () & () & \vdots & \psi_{j,k}(t) = 2^{j/2} \psi(2^{j} t - k) & () & if \quad f(t) \in v_{j} \Rightarrow J \\ () & () & \vdots & \psi_{j,k}(t) = 2^{j/2} \psi(2^{j} t - k) & () & if \quad f(t) \in v_{j} \Rightarrow J \\ () & () & \vdots & \psi_{j,k}(t) = 2^{j/2} \psi(2^{j} t - k) & () & if \quad f(t) \in v_{j} \Rightarrow J \\ () & () & \vdots & \psi_{j,k}(t) = 2^{j/2} \psi(2^{j} t - k) & () & if \quad f(t) \in v_{j} \Rightarrow J \\ () & () & \vdots & \psi_{j,k}(t) = 2^{j/2} \psi(2^{j} t - k) & () & if \quad f(t) \in v_{j} \Rightarrow J \\ () & () & \vdots & \psi_{j,k}(t) = 2^{j/2} \psi(2^{j} t - k) & () & if \quad f(t) \in v_{j} \Rightarrow J \\ () & () & \vdots & \psi_{j,k}(t) = 2^{j/2} \psi(2^{j} t - k) & () & if \quad f(t) \in v_{j} \Rightarrow J \\ () & () & () & \vdots & \psi_{j,k}(t) = 2^{j/2} \psi(2^{j} t - k) & () & \vdots & \psi_{j,k}(t) = 2^{j/2} \psi(2^{j} t - k) & () & \vdots & \psi_{j,k}(t) = 2^{j/2} \psi(2^{j} t - k) & () & \vdots & \psi_{j,k}(t) = 2^{j/2} \psi(2^{j} t - k) & () & \vdots & \psi_{j,k}(t) = 2^{j/2} \psi(2^{j} t - k) & () & \vdots & \psi_{j,k}(t) = 2^{j/2} \psi(2^{j} t - k) & () & \vdots & \psi_{j,k}(t) = 2^{j/2} \psi(2^{j} t - k) & () & \vdots & \psi_{j,k}(t) = 2^{j/2} \psi(2^{j} t - k) & () & \vdots & \psi_{j,k}(t) = 2^{j/2} \psi(2^{j} t - k) & () & \psi_{j,k}(t) = 2^{j/2} \psi(2^{j} t - k) & () & \psi_{j,k}(t) = 2^{j/2} \psi(2^{j} t - k) & () & \psi_{j,k}(t) = 2^{j/2} \psi(2^{j} t - k) & () & \psi_{j,k}(t) = 2^{j/2} \psi(2^{j} t - k) & () & \psi_{j,k}(t) = 2^{j/2} \psi(2^{j} t - k) & ($$

$$\begin{aligned} v_{j+1} &= w_j \oplus w_{j-1} \oplus v_{j-1} = \dots = \\ w_j \oplus w_{j-1} \oplus w_{j-2} \oplus \dots \oplus w_{j-J} \oplus v_{j-J} \end{aligned}$$
()

$$\lim_{j \to -\infty} v_j = \{0\}$$
 ()

$$\lim_{j \to \infty} v_j = L^2(R) \tag{)}$$

$$f(t) \in v_j \Leftrightarrow f(2^*t) \in v_{j+1}$$
 ()

$$f(t) \in v_j \Leftrightarrow f(t-k) \in v_j \tag{)}$$

$$: \qquad v_0$$

$$: ; v_0 = \overline{span\{\varphi_k(t)\}} \quad \varphi_k(t) = \varphi(t-k) \qquad ()$$

$$k$$

$$f(t) = \sum_{k} a_{k} \cdot \varphi_{k}(t) \quad f(t) \in v_{0} \text{ for } ()$$

$$v_{j} \qquad \qquad \varphi_{j,k}(t)$$

$$\vdots$$

$$v_j = \overline{span\{\varphi_{j,k}(t)\}}$$
 ()

$$\varphi_{j,k}(t) = 2^{j/2} \varphi(2^j t - k)$$
 ()

if
$$f(t) \in v_j \Rightarrow f(t) = \sum_k a_k \varphi(2^j t - k)$$
 ()
 $2^j \qquad \varphi_{j,k}(t)$
 $k \times 2^{-j}$

$$\varphi_{j,k}(t) \qquad j > 0$$

$$\varphi_{j,k}(t) \qquad (j > 0)$$

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$$\begin{split} s_{l} &= \int_{-\infty}^{+\infty} \varphi(x-l) \frac{d}{dx} \varphi(x) dx & T \\ \gamma_{l} &= \int_{-\infty}^{+\infty} \varphi(x-l) \frac{d}{dx} \psi(x) dx; & T = \left\{ A_{j}, B_{j}, \Gamma_{j} \right\}_{j \in \mathbb{Z}} & () \\ & () & \vdots & \\ \left\{ \hat{d}^{j}, \hat{s}^{j} \right\} & T = \left\{ A_{j}, B_{j}, \Gamma_{j} \right\}_{j \in \mathbb{Z}; j \leq n-1}, T_{0} \right\} & () \end{split}$$

 $\left\{\left\{d^{j}\right\}, s_{0}\right\}$

= d²

 $: \left\{ \left\{ d^{j} \right\}, \left\{ s^{j} \right\} \right\}$

3

 $\begin{array}{c|c} A_1 & B_1 \\ \hline & \Gamma_1 & T_1 \end{array}$

 $\left\{\left\{\hat{d}^{j}\right\},\left\{\hat{s}^{j}\right\}\right\}$

 \hat{d}^2

 $j = 0, 1, \dots, n-1$

[]

 A_2 B₂

 Γ_2

$$T_0 = P_0 T P_0 \tag{()}$$

$$T = \sum_{j=1}^{+\infty} (Q_j T Q_j + Q_j T P_j + P_j T P_j) + P_0 T P_0 \qquad ()$$

$$(NS)$$

$$d^i, s^i \qquad ()$$

() . NS
$$\hat{d}^i, \hat{s}^i$$

 d/dx

Db12

.[]

 $\frac{d}{dx}$

 $\alpha^{j}, \beta^{j}, \gamma^{j}, s^{j}$



 $\alpha_{il}^{\,j} = 2^{\,j} \int_{-\infty}^{+\infty} \psi(2^{\,j} \, x - i) \psi'(2^{\,j} \, x - l) . 2^{\,j} \, dx = 2^{\,j} \alpha_{i-l}$ $\beta_{il}^{\,\,j} = 2^{\,j} \int_{-\infty}^{+\infty} \psi(2^{\,j} \, x - i) \varphi'(2^{\,j} \, x - l) . 2^{\,j} \, dx = 2^{\,j} \, \beta_{i-l}$ $\gamma_{il}^{j} = 2^{j} \int_{-\infty}^{+\infty} \varphi(2^{j} x - i) \psi'(2^{j} x - l) . 2^{j} dx = 2^{j} \gamma_{i-l}$ $s_{il}^{j} = 2^{j} \int_{-\infty}^{+\infty} \varphi(2^{j} x - i) \varphi'(2^{j} x - l) \cdot 2^{j} dx = 2^{j} s_{i-l}$

[] PDEs

semi group

$$\begin{split} \beta_l &= \int_{-\infty}^{+\infty} \psi(x-l) \frac{d}{dx} \varphi(x) dx \\ \alpha_l &= \int_{-\infty}^{+\infty} \psi(x-l) \frac{d}{dx} \psi(x) dx; \end{split}$$

:

$$Q_{0}(\widehat{\otimes}\Delta t) = e^{\widehat{\otimes}\Delta t}$$

$$\begin{pmatrix} & \\ & \end{pmatrix}$$

$$Q_{1}(\widehat{\otimes}\Delta t) = (e^{\widehat{\otimes}\Delta t} - \widehat{\heartsuit})(\widehat{\otimes}\Delta t)^{-1}$$

$$Q_{2}(\widehat{\otimes}\Delta t) = (e^{\widehat{\otimes}\Delta t} - \widehat{\heartsuit} - \widehat{\otimes}\Delta t)(\widehat{\otimes}\Delta t)^{-2}$$

SH

(x, z)

.
$$f_y(x, z), \mu(x, z), \rho(x, z), v_y(x, z), u_y(x, z)$$

SH

$$\rho \frac{\partial^2 u_y}{\partial t^2} = \frac{\partial}{\partial x} \left(\mu \frac{\partial u_y}{\partial x} \right) + \frac{\partial}{\partial z} \left(\mu \frac{\partial u_y}{\partial z} \right) + f_y \qquad ()$$

$$\frac{\partial^2 u_y}{\partial t^2} = \bigotimes_y + \frac{f_y}{\rho} \tag{()}$$

$$\bigotimes_{y} = \frac{1}{\rho} \frac{\partial}{\partial x} \left(\mu \frac{\partial u_{y}}{\partial x} \right) + \frac{1}{\rho} \frac{\partial}{\partial z} \left(\mu \frac{\partial u_{y}}{\partial z} \right)$$
()
semi group

$$\frac{\partial v_y}{\partial t} = \bigotimes_y u_y + \frac{f_y}{\rho} , \frac{\partial u_y}{\partial t} = v_y$$
:
()

$$\mathbf{U} = \mathbf{L}\mathbf{U} + \mathbf{F} \tag{()}$$

$$\mathbf{U} = \begin{pmatrix} u_y \\ v_y \end{pmatrix}; \mathbf{L} = \begin{pmatrix} 0 & \mathbf{I} \\ \boldsymbol{\bigotimes}_y & 0 \end{pmatrix}; F = \frac{1}{\rho} \begin{pmatrix} 0 \\ f_y \end{pmatrix}$$
()

:

$$\mathbf{U}_{n+1} = e^{\Delta t \mathbf{L}} \mathbf{U}_n + \Delta t \boldsymbol{.} \boldsymbol{\beta}_0 \boldsymbol{.} \mathbf{F}_n \ \gamma = 0 \ \& \ M = 1 \Longrightarrow \quad ()$$

$$\ln u_{,t} = \bigotimes u + \$ f(u) \quad \Omega \in \mathbb{R}^d \qquad ()$$

$$\ln t \in [0,T], \partial \Omega \in \mathbb{R}^{d-1} \quad \text{On} \quad \bigotimes u(x,t) = 0 \quad \Omega;$$

$$u(x,0) = u_0(x)$$

$$(x,0) \qquad (x,0) \qquad (x,0) \qquad (x,t)$$
semi group .

. : $u(x,t) = e^{t. \bigotimes} u(x,0) + \int_0^t e^{(t-\tau) \bigotimes} \bigotimes (u(x,\tau)) d\tau \quad \left(\begin{array}{c} \end{array} \right)$

$$\ensuremath{\mathfrak{S}}$$
 . $u(x,t)$

$$u_n = u(x, t_n) \qquad \Delta t \qquad t_n = t_0 + n \Delta t$$
$$N_n \equiv \clubsuit (u(x, t_n))$$

$$u_{n+1} = e^{q.l.\Delta t} u_{n+1-l} + \Delta t (\gamma . N_{n+1} + \sum_{m=0}^{M-1} \beta_m . N_{n-m}) \quad ()$$

$$M + 1$$

$$\cdot q.\Delta t \quad \beta_m \quad \gamma \qquad \cdot \quad l \le M$$

$$\gamma = 0$$

$$\gamma = 0, l = 1$$
 ()
 $\beta_n \gamma M = 1, 2, 3$
 \vdots () ()

$$Q_j(x) = \frac{e^x - E_j(x)}{x^j} \tag{()}$$

$$E_{j}(x) = \sum_{k=0}^{j-1} \frac{x^{k}}{k!}$$
 ()

$$Q_k = Q_k (\bigotimes \times \Delta t) \tag{)}$$

$$Q_{j}(\widehat{\otimes}\Delta t) = \frac{e^{\widehat{\otimes}\Delta t} - E_{j}(\widehat{\otimes}\Delta t)}{\left(\widehat{\otimes}\Delta t\right)^{j}} \tag{()}$$

$$E_{j}(\textcircled{B}\Delta t) = \sum_{k=0}^{j-1} \frac{\left(\textcircled{B}\Delta t\right)^{k}}{k!}; j = 0, 1, \dots \qquad ()$$

_	. $\gamma = 0, l = 1$:	
М	$eta_{_0}$	eta_1	eta_2	order
	Q_1	0	0	
	$Q_1 + Q_2$	$-Q_{2}$	0	
	$Q_1 + 3Q_2 / 2 + Q_3$	$-2(Q_2 + Q_3)$	$Q_2 / 2 + Q_3$	

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- 1 Multiresolution
- 2 Resolution
- 3 Support
- 4 Compact
- 5 NS-Form