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Journal of Applicable Chemistry

2019, 8 (5): 2255-2285

(International Peer Reviewed Journal)

New Chemistry News

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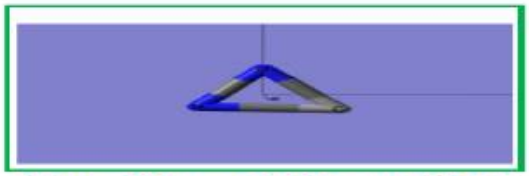
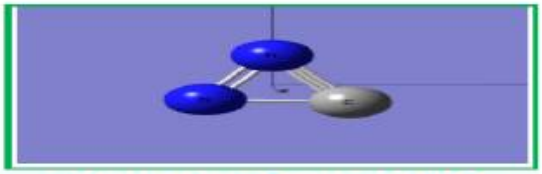


New News of Chem (NNC)



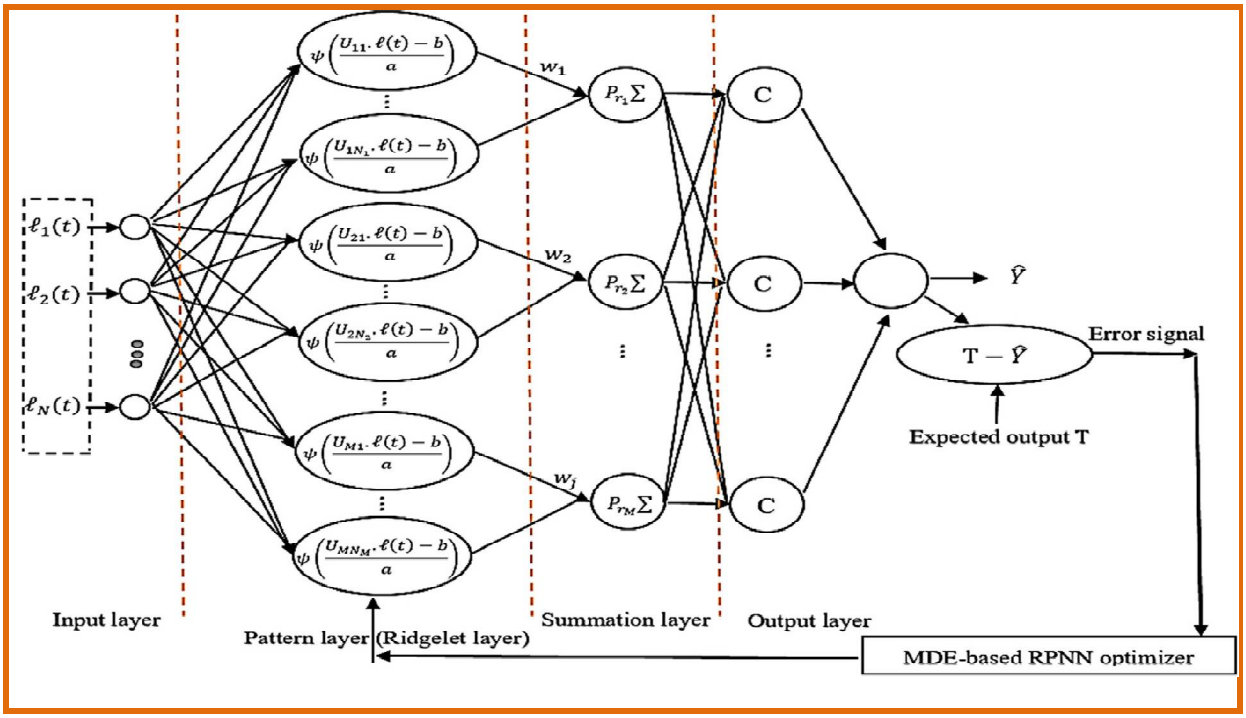
ChemNewsNew (CNN)

Ridgelets

[Wave; Ridge ; Curve; Surf; Brush] lets

Neural Network + ridgelets +

Ridgeletprobabilistic neural network (RidgeProbNN)



Architecture	Feedforward- SLP (I#-H#-O#)
Training W	Modified differential evolution (MDF) algorithm new mutation phase, crossover process; selection mechanism
Discipline	Ele eng
Task	Islanding detection Distributed generation

Islanding detection method using ridgelet probabilistic neural network in distributed generation

Neurocomputing, 329(2019) 188-209, doi.org/10.1016/j.neucom.2018.10.053

Masoud Ahmadipour and Hashim Hizam and Mohammad Lutfi Othman and MohdAmranRadzi

Ridgelet—Ridgelet--Ridgelet—Ridgelet--Ridgelet—Ridgelet--Ridgelet—Ridgelet--Ridgelet—

Ridgelet NN	Single-hidden-layer regularization ridgelet network
Architecture	FeedForward
Cost Fn	Cost function + Extra regular item (indicating prior knowledge of task) →Better generalization performance
Tunable parameters	Ridgelet hidden neurons + their parameters
Training W	o Extreme & incremental learning (CFM-EIL) algorithm + Simple, efficient
	Tuned o Incrementally; analytically + Significant reduction in computational complexity of ✓ Gradient based ✓ Iterative algorithms
Discipline	o Time-series forecasting
Data	Simulation o Macky_Glass times eries

	Experimental o Sunspots series -- Forecasting

Extreme and incremental learning based single-hidden-layer regularization ridgelet network	Neurocomputing,74(2011)1809-1814, doi.org/10.1016/j.neucom.2010.06.035
Shuyuan Yang and Min Wang and Licheng Jiao	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Multiscale transform bases	o Slantlet Transform
NN	o Ridgelet Probabilistic Neural Network
Application	▪ Three-phase grid-connected photovoltaic system
Data	Simulation o All possible grid faults o Switching transients o Islanding events
Task	o Islanding detection
Procedure	Step 1: Compute energy, mean value, minimum, maximum, range, standard deviation and log energy/ entropy at any decomposition level of Slantlet Transform for parameter detection Step 2: Ridgelet Probabilistic Neural Network Step 3: Prediction of islanding and none islanding states
Training Free Par	▪ Modified differential evolution algorithm ▪ New mutation phase, crossover process, selection mechanism
FOM	Improved accuracy of islanding detection

Islanding detection technique using Slantlet Transform and Ridgelet Probabilistic Neural Network in grid-connected photovoltaic system	Applied Energy, 231(2018)645-659, doi.org/10.1016/j.apenergy.2018.09.145
Masoud Ahmadipour and Hashim Hizam and Mohammad Lutfi Othman and MohdAmranMohdRadzi and AvinashSrikanta Murthy	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

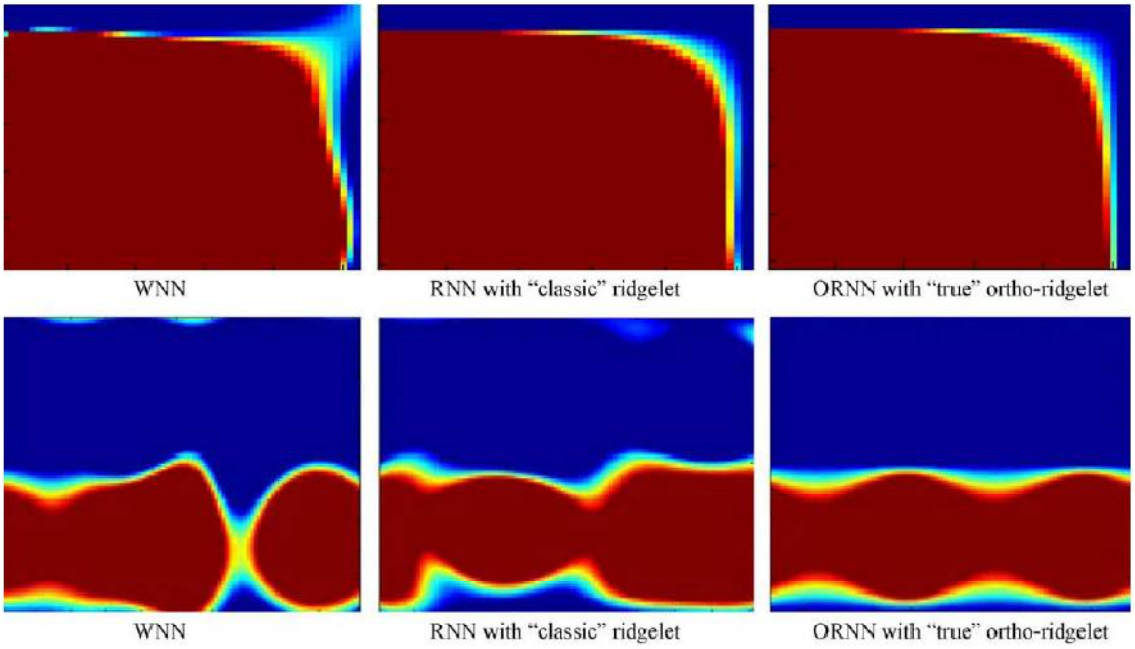
A novel islanding detection technique using modified Slantlet transform in multi-distributed generation	International Journal of Electrical Power & Energy Systems, 112(2019)460-475, doi.org/10.1016/j.ijepes.2019.05.008
Masoud Ahmadipour and Hashim Hizam and Mohammad Lutfi Othman and MohdAmranMohdRadzi and NiktaChireh	

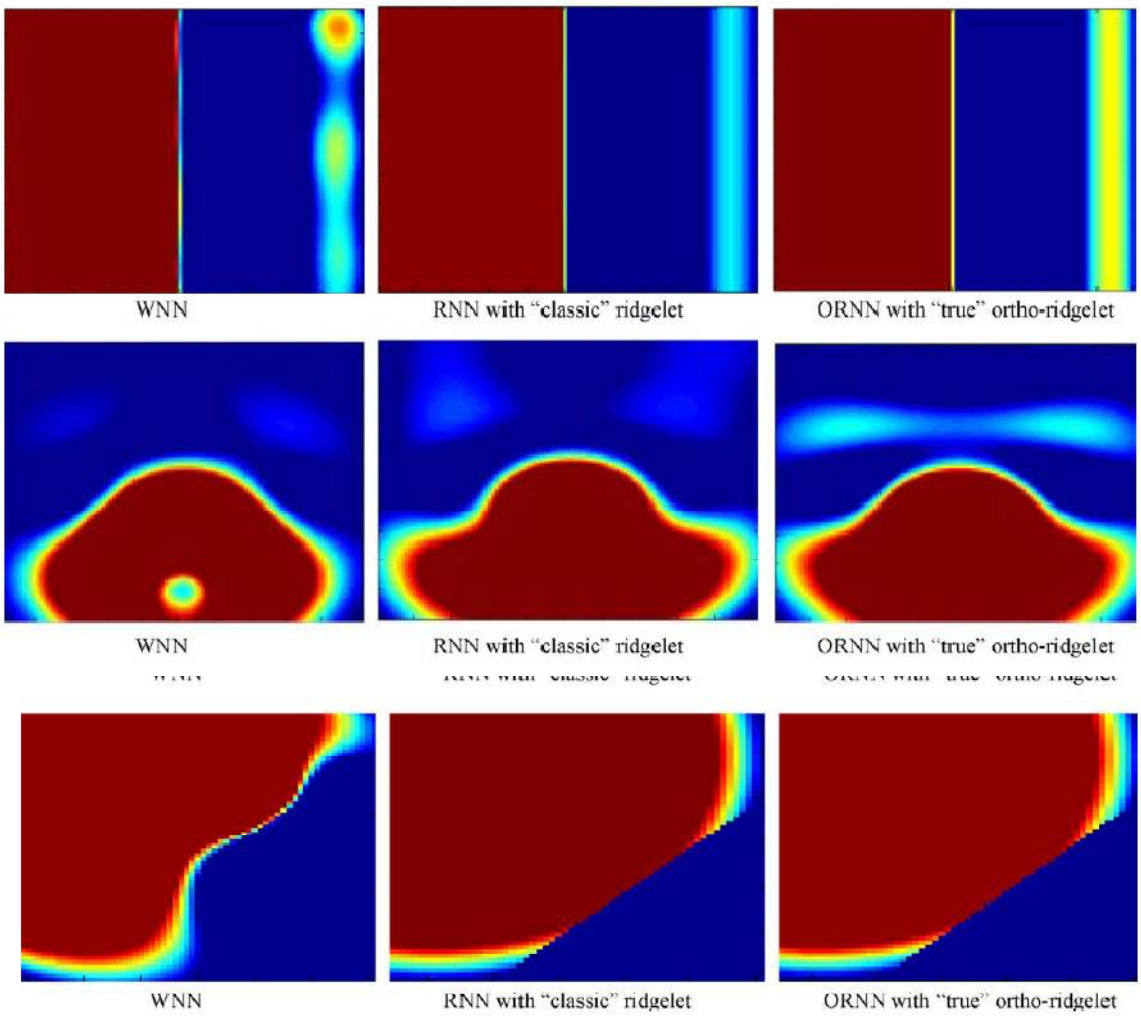
Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Method.	Ortho-ridgelet
NNs	🕮 Ortho-ridgelet NN 🕮 Time-varied ortho-ridgelet neural network (TV-ORRN)
	🕮 Activation function of the hidden neurons
NN training	✓ Incremental learning, Extreme machine learning

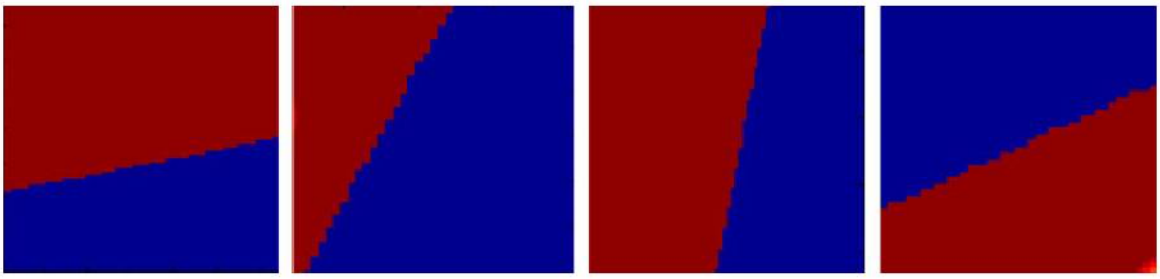
	(three phase)
Application	✓ More efficient representation of a set of functions with linear and curvilinear singularities ✓ Spatial inhomogeneity
Test Functions	

singular fns	singularity shape
1)	Square
2)	Wave
3)	Linear; band
4)	Hat
5)	Slant

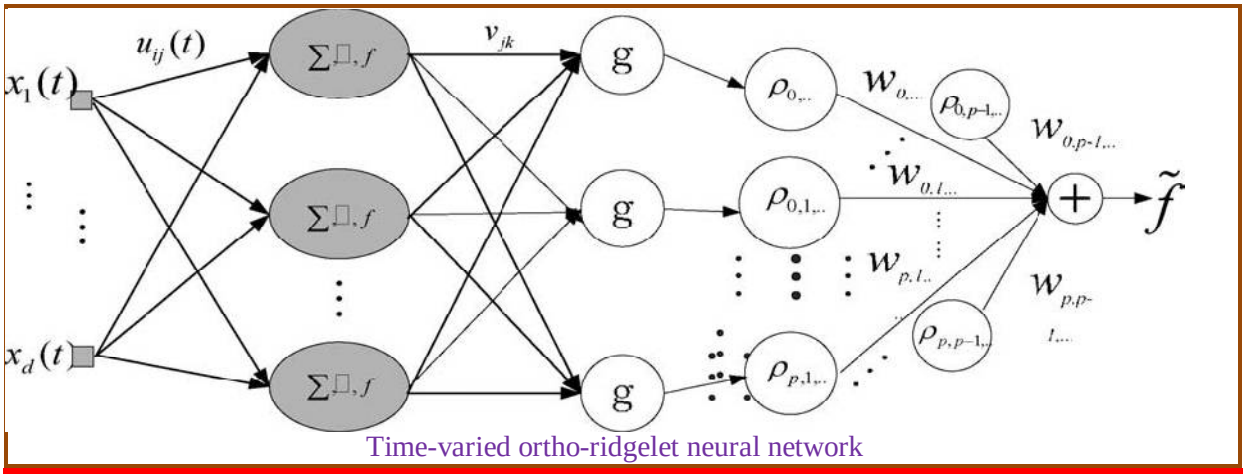




Approximation result of 2-d singular function with linear and curvilinear singularities



Captured singularities of time-varied ortho-ridgelet NN

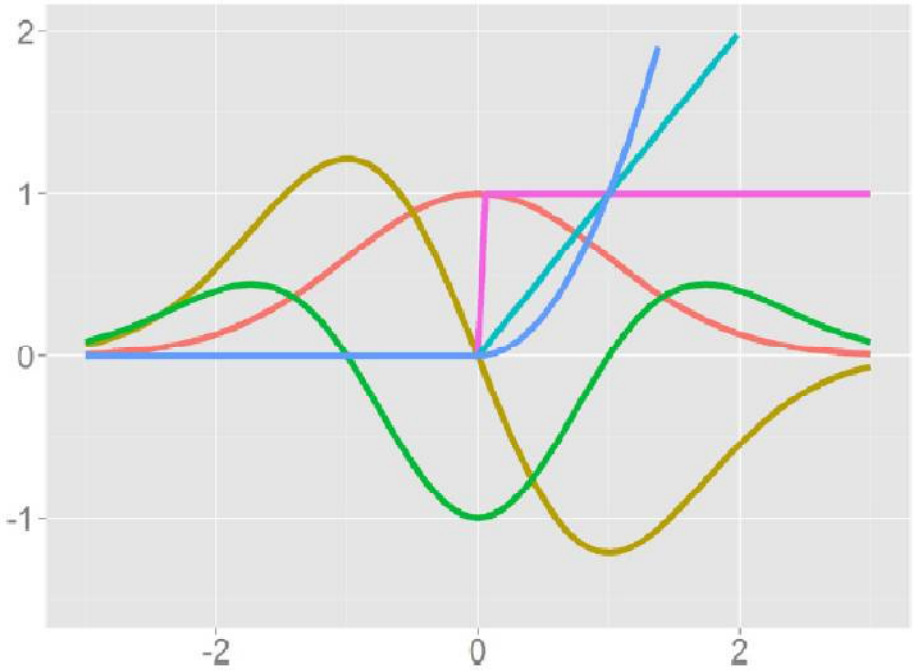


Time-varied ortho-ridgelet neural network

Approximation of functions with spatial inhomogeneity based on "true" ortho-ridgelet neural network	Applied Soft Computing, 11(2011)2444-2451, doi.org/10.1016/j.asoc.2010.09.006
Shuyuan Yang and Min Wang and Licheng Jiao	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Multiscale transform bases	Ridgelet transform with respect to Lizorkin distributions
Task	Rectified linear unit (ReLU) NN
NN	Neural network with unbounded activation functions still satisfies the universal approximation property
NN and Ridgelet	▪ Ridgelet transform, or the backprojection filter in the Radon domain, is what network learns after backpropagation ▪ Trained network can be obtained by simply discretizing the ridgelet transform, without backpropagation



Zoo of activation functions: the Gaussian G(z)(red), the first derivative G'(z)(yellow), the second derivative G''(z)(green); a truncated power function z2+(blue), the ReLU z+(sky blue), the unit step function z0+(rose)

Neural network with unbounded activation functions is universal approximator	Applied and Computational Harmonic Analysis, 43(2017)233-268, doi.org/10.1016/j.acha.2015.12.005
ShoSonoda and Noboru Murata	
Incremental constructive ridgelet neural network	Neurocomputing, 72(2008)367-377, doi.org/10.1016/j.neucom.2008.01.001
Shuyuan Yang and Min Wang and Licheng Jiao	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Higher-rank wavelet transforms, ridgelet transforms, and Radon transforms on the space of matrices	Applied and Computational Harmonic Analysis, 21(2006)182-203, doi.org/10.1016/j.acha.2006.01.002
GesturÓlafsson and Elena Ournycheva and Boris Rubin	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Incremental constructive ridgelet neural network	Neurocomputing, 72(2008)367-377, doi.org/10.1016/j.neucom.2008.01.001
Shuyuan Yang and Min Wang and Licheng Jiao	

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Higher-rank wavelet transforms, ridgelet transforms, and Radon transforms on the space of matrices	Applied and Computational Harmonic Analysis, 21(2006)182-203, doi.org/10.1016/j.acha.2006.01.002

GesturÓlafsson and Elena Ournycheva and Boris Rubin

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Regression + Ridgelet

Method.proposed	✓ Ridgelet kernel regression	
Components of MethodFlow	✓ Ridgelet ✓ Kernel ✓ Regularization ✓ Quadratic programming ✓ ✓ Solution Obtained used to define a fitness function ✓ PSO: for optimizing directions of ridgelets	
Task	▶ Approximation	Multi-dimensional functions Constraints : Certain kinds of spatial inhomogeneities
Advantages	Properties of ridgelet	+ Guarantee stability + Superiority for functions with linear singularities
	Regularized	+ Model →smaller generalization error

Ridgelet kernel regression	Neurocomputing, 70(2007)3046-3055, doi.org/10.1016/j.neucom.2006.05.015
Shuyuan Yang and Min Wang and Licheng Jiao	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Ridgelet + Complex numbers

Method.proposed:	✓ Complex ridgelet transform
Unique. Features	🕮 Shift invariance and good performance for line singularities 🕮 Not possible with wavelet-based methods in surface metrology 🕮 Achieved by dual-tree complex wavelet transform on the projections of the finite radon transform
Task	▶ Shift invariant characterization of surface topography
Applicable to	✓ Signal processing in ▪ Physics and engineering
Wavelet	Limitations ✓ Lack of shift invariance ✓ Aliasing → unlikely to give consistent results when used to detect key features in surface topographie poor performance at representing line or higherdimensional

	✓ Singularities, → edges not to be smooth when extracting line scratches from surfaces
Future research	✓ wavelets + ridgelets will be more efficient

Complex ridgelets for shift invariant characterization of surface topography with line singularities	Physics Letters A, 344(2005)423-431, doi.org/10.1016/j.physleta.2005.06.091
Jianwei Ma and Xiangqian Jiang and Paul Scott	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Non-linear Function approximation

Method	Ridgelets
Task	Nonlinear pproximation of functions
Constraint	Line singularities

On the approximation of functions with line singularities by ridgelets	Journal of Approximation Theory, 237(2019)30-95, doi.org/10.1016/j.jat.2018.05.003
Axel Obermeier and Philipp Grohs	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Method.proposed:	Modified curvelet transform (MCT)
Method	MCT 📖 Ridgelet transform used 📖 Implements curvelet sub-bands ,using a filter bank of gabor wavelet filters
DataSets	o Corel image database
Comparision	Better than ACT (à trous wavelet transform); GT (Gabor transform)
FOM	+ Weighted average precision + Average precision + Average retrieval rate + Average rank

Modified curvelet transform with vocabulary tree for content based image retrieval	Digital Signal Processing, 23(2013)142-150, doi.org/10.1016/j.dsp.2012.04.019
Anil Balaji Gonde and R.P. Maheshwari and R. Balasubramanian	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Method.	Finite ridgelet transform

Limitation	- Suitable for images of prime-pixels length only
Application	✓ Images of dyadic length
Tested for	✓ Denoising of images embedded in additive white Gaussian noise + Better performance

A new digital implementation of ridgelet transform for images of dyadic length	Journal of Network and Computer Applications,30(2007)1346-1355, doi.org/10.1016/j.jnca.2006.09.002
Junjun Xia and Lin Ni and Y. Miao	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Multiscale transform bases	Ridgelets	
Method.proposed:	✓ Monoscale orthonormal ridgelet frame (MORF)	
Task	Nonlinear approximation	Of imagewith edge
Applications	Image Compression Reconstruction Denoising	

Nonlinear approximation of image based on monoscale orthonormal ridgelets frame	Journal of Systems Engineering and Electronics, 18(2007)806-810, doi.org/10.1016/S1004-4132(08)60024-9
Lu Chengwu and Song Yimei and Song Guoxiang	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Multiscale transform bases	o Partial finite ridgelet distortion search o Radon transform
Task	o Edge sensitive o Block distortion similarity/ disparity measure
Reconstruction	o Stereo vision applications

Block-based disparity estimation by partial finite ridgelet distortion search (PFRDS)",	Optics and Lasers in Engineering, 48(2010)125-131, doi.org/10.1016/j.optlaseng.2009.08.004
Mohammad Eslami and Farah Torkamani-Azar	

Ridgelet—Ridgelet--Ridgelet—Ridgelet--Ridgelet—Ridgelet--Ridgelet—Ridgelet--Ridgelet—

Multiscale transform bases	o Curvelets + Represents edges better than wavelets + To combine decomposed planes for getting better edge quality
	o Support value transform (SVT) o LS-SVM (least square support vector machine)
Task	o Optical image fusion

Optical image fusion using support value transform (SVT) and curvelets	Optik, 126(2015)1672-1675, doi.org/10.1016/j.ijleo.2015.04.057
S. Sulochana and R. Vidhya and R. Manonmani	

Ridgelet—Ridgelet--Ridgelet—Ridgelet--Ridgelet—Ridgelet--Ridgelet—Ridgelet--Ridgelet—

Multiscale transform bases	o Gabor frames o Directional time–frequency analysis o Frame theory
Math.Stat Methods	o Support value transform (SVT) o LS-SVM (least square SVM)
Task	o Representation of functions

Gabor frames and directional time–frequency analysis	Applied and Computational Harmonic Analysis, 25(2008) 47-67, doi.org/10.1016/j.acha.2007.09.004
Loukas Grafakos and Christopher Sansing	

Ridgelet—Ridgelet--Ridgelet—Ridgelet--Ridgelet—Ridgelet--Ridgelet—Ridgelet--Ridgelet—

Classification

Multiscale transform bases	Finite radon transform (FRT)
Application	Square arrays of arbitrary size

Generalised finite radon transform for N×N images	Image and Vision Computing, 25(2007)1620-1630, doi.org/10.1016/j.imavis.2006.03.002
Andrew Kingston and ImantsSvalbe	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

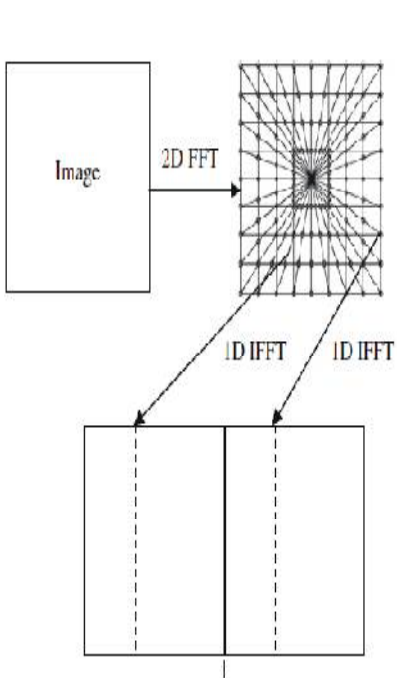
Discipline	o Computer-aided diagnosis
Task	o Texture classification; Non-morphological features in mammograms
DataSets	o 120 cranio-caudal mammograms o 60 with mass rated as abnormal images o 60 with no lesions
Features	Texture patterns: ✓ Entropy ✓ Energy ✓ Sum average ✓ Sum variance ✓ Cluster tendency

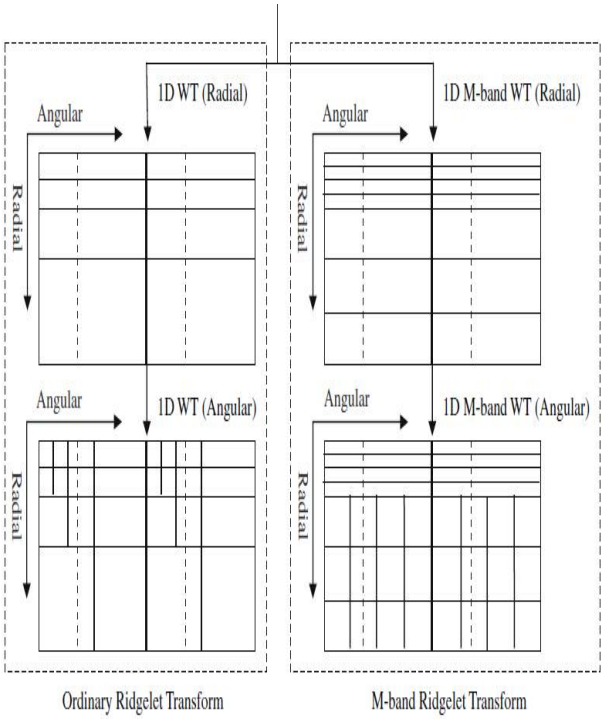
Texture extraction: An evaluation of ridgelet, wavelet and co-occurrence based methods applied to mammograms	Expert Systems with Applications, 39(2012)11036-11047, doi.org/10.1016/j.eswa.2012.03.020

Rodrigo Pereira Ramos and Marcelo Zanchetta do Nascimento and Danilo Cesar Pereira

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Multiscale transform bases	M-band ridgelet, M-band wavelet
Task	Classification
Appln	Texture classification
DataSets	Two benchmark texture databases
Performace	Superior performance





M-band ridgelet transform based texture classification

Pattern Recognition Letters, 31(2010)244-249, doi.org/10.1016/j.patrec.2009.10.007

Yu-Long Qiao and Chun-Yan Song and Chun-Hui Zhao

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Multiscale transform bases	o Ridgelet
Application	o Classification Texture
DataSets	

Data set #	1	2	3	4
Images (textue)	20	30	112	129

Texture classification using ridgelet transform	Pattern Recognition Letters, 27(2006)1875-1883, doi.org/10.1016/j.patrec.2006.04.013
S. Arivazhagan and L. Ganesan and T.G. Subash Kumar	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Discipline	o Computer-aided diagnosis
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Rodrigo Pereira Ramos and Marcelo Zanchetta do Nascimento and Danilo Cesar Pereira	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Multiscale transform bases	Ridgelet	Mexican-hat
Task	Classification	
DataSets	Images	Cyclic and dihedral symmetric
Data	Image + Additive white Gaussian noise	
Method	o Mexican-hat wavelet domain o Continuous Mexican-hat ridgelet ▶ To detect those zero-crossing lines	
Advantages compared to others	+ Very robust against noise + Automatic classification	

A noise-robust algorithm for classifying cyclic and dihedral symmetric images	Chaos, Solitons & Fractals, 42(2009)676-685, doi.org/10.1016/j.chaos.2009.01.042
Jian Lu and Yuru Zou and Zhongxing Ye and Wensheng Chen	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Data	o Image	o Shoeprint
Task	o Classification automated o Retrieval system	
Difficulties	Shoeprint classification - Device-dependent noise	

	- Distortions - Incompletenes	
Methods	**Statistics** o First order o Second order	**Multiscale** o Ridgelet

Image quality measures for hierarchical decomposition of a shoeprint image	Forensic Science International, 163(2006) 125-131, doi.org/10.1016/j.forsciint.2005.11.031
H. Su and A. Bouridane and D. Crookes	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

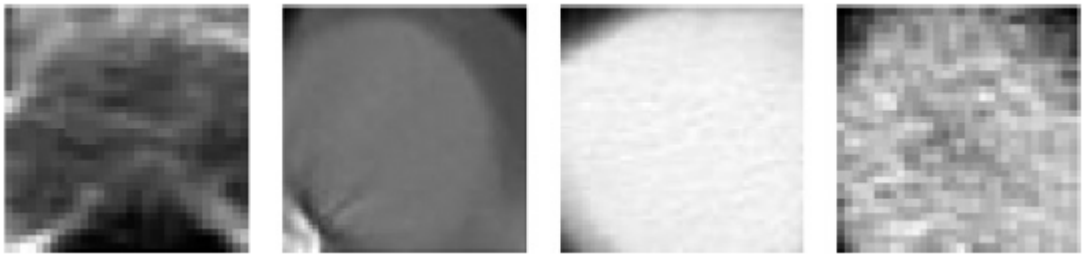
Multiscale transform bases	o Ridgelet With linear subspace	
Data	o Image 3D Acquisition Photometric stereo	o Face
Task	o Recognition	

Face recognition in 2D and 2.5D using ridgelets and photometric stereo	Pattern Recognition, 45(2012)3317-3327, doi.org/10.1016/j.patcog.2012.03.007
Satyajit N. Kautkar and Gary A. Atkinson and Melvyn L. Smith	

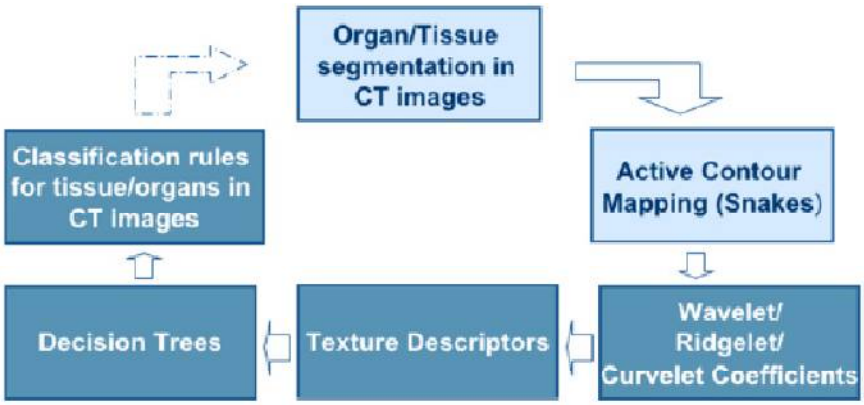
Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet—Ridgelet

Medical diagnosis

Multiscale transform bases	Ridgelet, wavelet, curvelet
Method.proposed:	▪ Automatic extraction of the most discriminative texture features of regions of interest ▪ Creation of a classifier that automatically identifies the various tissues
Discipline	Computed tomography
Task	Classification of normal tissues in CT scans
Data	Normal tissues in medical images
FOM	🕮 Curvelet- better than Ridgelet, wavelet



DICOM images (backbone, heart, liver, kidney).



A comparison of wavelet, ridgelet, and curvelet-based texture classification algorithms in computed tomography	Computers in Biology and Medicine, 37(2007) 486-498, doi.org/10.1016/j.compbiomed.2006.08.002
Lucia Dettori and Lindsay Semler	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Image:	*Mammograms*		
Object:	*Malignant masses*	**Organ:**	*Breast*
Task. Math	*Classification*	**Task.sub.**	*Feature extraction*
Goal	*Diagnosis.Clinical.invasive*		

Methods	Hybrid methods o Wavelet-CT1 o Wavelet-CT2 o ST-GLCM
Method-flow	o CT1 is applying Contourlet at level 4. o CT2 is applying Contourlet at levels [4321]. o GLCM uses seven texture features. Wavelet-CT1 applies CT1 method to all bands of wavelet coefficients at level one o Wavelet-CT2 is merging high frequency bands of wavelet at level one with contourlet coefficients of CT2 o ST-GLCM merges seven statistical features and seven texture features extracted from Grey level Co-occurrence Matrix (GLCM)

Comparision	o Discrete wavelet o Ridgelet o Curvelet transform o Svm for classification	
DataSets	o Images from Digital Database for Screening Mammography (DDSM) o Mammograms Image Analysis Society (MIAS) database	**Data** sub-images seven texture features

Hybrid methods for feature extraction for breast masses classification	Egyptian Informatics Journal, 19(2018)63-73, doi.org/10.1016/j.eij.2017.08.001
Mohamed A. Berbar	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Method	Spherical ridgelets
Data sets	Human in vivo data sets
Appln	Recovery of multi-shell diffusion imaging (MSDI) data
Advantage	Aaccurate modeling the monotonically decreasing radial component of the diffusion signal→ novel extension to the framework of spherical ridgelets

Multi-shell diffusion signal recovery from sparse measurements	Medical Image Analysis, 18(2014)1143-1156, doi.org/10.1016/j.media.2014.06.003
Y. Rathi and O. Michailovich and F. Laun and K. Setsompop and P.E. Grant and C.-F. Westin	

Ridgelet—Ridgelet--Ridgelet—Ridgelet--Ridgelet—Ridgelet--Ridgelet—Ridgelet--Ridgelet—

Multiscale transform bases	o Ridgelet	o Opthamology	o Med Diagnosis
Data	o Images	o Color fundus	
DataSets	o Forty healthy OCT (Symmetry analysis of Optical Coherence Tomography)datasets o 650 × 512 × 128 (acquired from Topcon 3D OCT-1000) o Corresponding 1536 × 1612 fundus images		
Expt	o OCT B-scans o OCT images in right and left eyes		
	o Biomarkers for early detection of eye diseases		
Purpose	Investigate the symmetry between two eyes by calculating local cup to disc ratio (CDR) from each B-scan. It is based on fusion of fundus images and OCT B-scans.		
	Ridgelet transform Inner Limiting Membrane (ILM) and Retinal Pigment Epithelium (RPE) layers are extracted using ridgelet transform Disc-edge point and cup-edge point in each B-scan are found		

Local comparison of cup to disc ratio in right and left eyes based on fusion of color fundus images and OCT B-scans	Information Fusion, 51(2019)30-41, doi.org/10.1016/j.inffus.2018.10.010

Marzieh Mokhtari and Hossein Rabbani and Alireza Mehri-Dehnavi and RahelehKafieh and Mohammad-Reza Akhlaghi and Mohsen Pourazizi and Leyuan Fang

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Discipline	Medical Diagnosis	Ortho-treatment
Task	bone fracture ; Despeckling of ultrasound images	
Data	Image Instru: Ultrasound	
Method	M-band ridgelet, M-band wavelet	
	M-band ridgelet transform ✓ Replacing 2-band wavelet transform to analyze edges and features in images + Overcomes the limitations of ordinary ridgelet transform	
Advantages compared to others	+ Removes speckle + Preserves edges and image details	

Despeckling of ultrasound images of bone fracture using M-band ridgelet transform	Optik, 125(2014)1417-1422, doi.org/10.1016/j.ijleo.2013.08.007

Deep Gupta and R.S. Anand and Barjeev Tyagi

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Task	Structure of different tissue types in the brain
Method	High spatial resolution dMRI images using multiple low resolution (LR) images + Reduces acquisition time + Improves signal-to-noise ratio (SNR)
Standard dMRI	✓ Proper analysis of medium-to-large white matter bundles in brain - Not possible to trace smaller fiber bundles connecting very small cortical or sub-cortical regions with large voxel sizes
Importance to trace fiber bundles	▪ Deep brain stimulation ; neurosurgery ▪ Brain disorders : Alzheimer's disease, Schizophrenia; mild traumatic brain injury
	Application & Prime need: ▪ To study neural architecture; connectivity of brain
dMRI Diffusion-weighted Magnetic Resonance Imaging	Principle: It utilizes multiple 3D-diffusion-weighted images → probes diffusivity of water along various directions
Compressed-Sensing Super Resolution Reconstruction	➔ Uses multiple overlapping thick-slice dMRI volumes that are under-sampled in q-space to reconstruct diffusion signal with complex orientations The proposed method combines twin concepts of compressed sensing + super-resolution → This method ➔ Models diffusion signal in spherical ridgelets basis

	Solution method for **CS-SRR** Alternating Direction Method Of Multipliers (ADMM)
Real Life Application	Several in-vivo human data sets To reconstruct sub-millimeter super resolution dMRI data

A joint compressed-sensing and super-resolution approach for very high-resolution diffusion imaging	NeuroImage, 125(2016)386-400, doi.org/10.1016/j.neuroimage.2015.10.061
Lipeng Ning and Kawin Setsompop and Oleg Michailovich and Nikos Makris and Martha E. Shenton and Carl-Fredrik Westin and Yogesh Rathi	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Finger print

Discipline	Detection	
Task	Fingerprint	Fake
DataSets	Fingerprints 185 Real 90 Fun-Doh 150 Gummy	
Method	Ridgelet, spoof, wavelet	
	PCA	Dimension reduction of feature variables

Ridgelet-based fake fingerprint detection	Neurocomputing, 72(2009)2491-2506, doi.org/10.1016/j.neucom.2008.11.003
Shankar BhausahebNikam and Suneeta Agarwal	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Face recognition

Multiscale transform bases	Ridgelet	
Task	Face	Recognition
DataSets	o Yale o AT&T	o Faces94 o Faces96 o Indian databases
Data	Normalization Ridgelet	
Method Flow	▶ Normalize image 🕮 Using a segmentation process based on **YCbCr** colour model →Detects largest region of skin in image ▶ Decomposed into a set of feature vectors	

	▶ Ridgelet Transform

Face recognition based on ridgelet transforms	Procedia Computer Science, 2(2010)35-43, doi.org/10.1016/j.procs.2010.11.006
Satyajit Kautkar and RahulkumarKoche and Tushar Keskar and Aniket Pande and Milind Rane and Gary A. Atkinson	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Multiscale transform bases	Directional systems o Ridgelets, curvelets, shearlets
Task	o Sparse approximation of video signals,
Data	o 3D data

Multivariate α-molecules	Journal of Approximation Theory, 202(2016)64-108, doi.org/10.1016/j.jat.2015.10.004
Axel Flinth and Martin Schäfer	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Multiscale transform bases	Ridgelet transform
Appln	Extended to Wiener functionals
Limitation	- Reconstruction property not satisfied

La transforméeenridelettes pour les fonctionnelles de Wiener	ComptesRendusMathematique, 350(2012)259-262, doi.org/10.1016/j.crma.2012.03.002
Claude Martias	

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Local appearance-based facerecognition using adaptive directional wavelet transform	Journal of King Saud University - Computer and Information Sciences, 31(2019)161-174, doi.org/10.1016/j.jksuci.2016.12.008
Mohd. Abdul Muqeet and Raghunath S. Holambe	

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Structural hidden Markov models for biometrics: Fusion of face and fingerprint	Pattern Recognition, 41(2008)852-867, doi.org/10.1016/j.patcog.2007.06.033
Djamel Bouchaffra and Abbes Amira	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet—Ridgelet—

$$$$

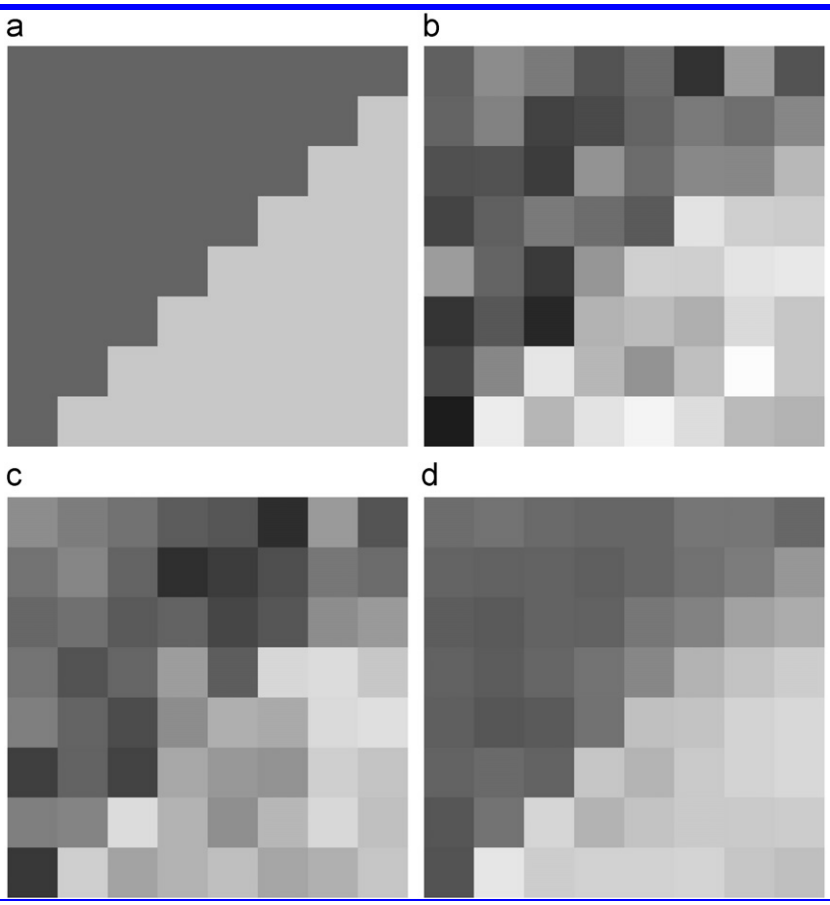
Image Analysis

Wavelet	✓ Identifies point-like features, such as noise or background stars - Cannot enhance visibility of the curved form of a typical CME (Coronal mass ejections) front
Ridgelets and curvelets	✓ Morphology (width, curvature) and kinematics (position, velocity, acceleration) of CMEs
Comparision	✓ Curvelets >> ridgelets
Discipline	Space weather applications
DataSets	Coronagraph images
Def.	**CMEs:** Large-scale eruptions of plasma and magnetic field → adverse space weather at Earth and in Heliosphere

Coronal mass ejection detection using wavelets, curvelets and ridgelets: Applications for space weather monitoring	Advances in Space Research, 47(2011)2118-2126, doi.org/10.1016/j.asr.2010.03.028
P.T. Gallagher and C.A. Young and J.P. Byrne and R.T.J. McAteer	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Method	Finite ridgelet transform		
Limitation	- Wrap-around effect of finite Radon transform → Limits its power greatly **Remedy:** Embedding it into a moving window pyramid		
Task	o Denoising o Detect line singularities of image	**Sub.task**	Wrap-around effect removal
Discipline	Pattern recognition	**Sub.Discipline**	Image

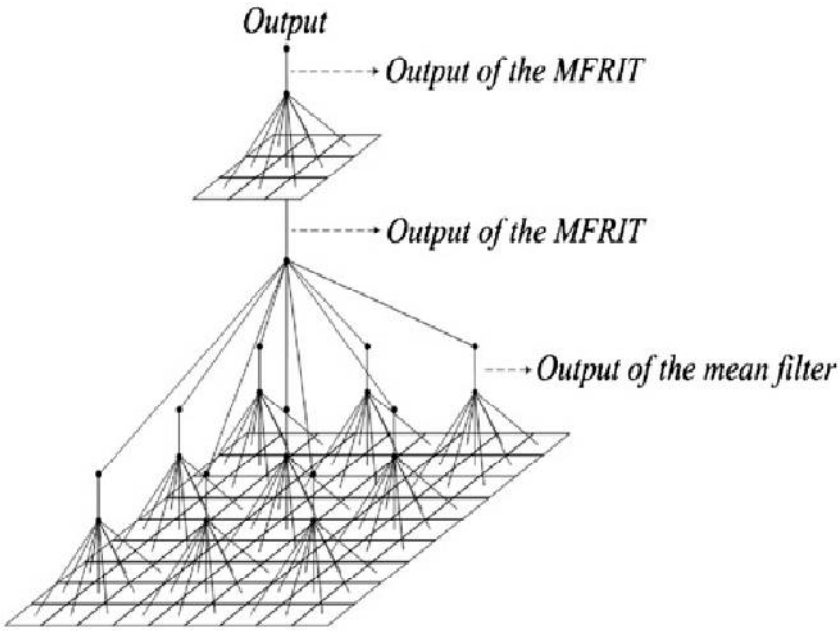


(a) Part of the zoomed edge image

(b) part of the zoomed noisy edge image

(c) part of the zoomed noisy edge image filtered by the FRIT

(d) part of the zoomed noisy edge image filtered by the MFRIT



Denoising procedure of the MFRIT

Window size: Nine at a pixel position of an image

- Finite ridgelet transform(FRIT)
- Modified FRIT (MFRIT

Wrap-around effect removal finite ridgelet transform for multiscale image denoising	Pattern Recognition, 43(2010)3693-3203, doi.org/10.1016/j.patcog.2010.05.032
Xin Wang	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

o Orthonormal basis for L2(R): o Functions • Well localized in the spatial domain • Have compact support in the frequency domain. o Construction of Fns based on • Smooth local cosine bases • Local exponentials in the frequency domain.	o Greedy brushlet-type bases o Derivation of Jackson and Bernstein inequalities o Investigation of a natural bivariate extension leading to ridgelet-type bases for L2(R2)

Approximation with brushlet systems	Journal of Approximation Theory, 123(2003) 25-51, doi.org/10.1016/S0021-9045(03)00083-2
Lasse Borup and Morten Nielsen	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Multiscale transform bases	o 2-D DCT bases o Gabor bases o Wavelet bases o Ridgelet bases
	o 3-D wavelets, ridgelets, beamlets, and curvelets , 3-D sparse representations on 3-D ball described
Hybrid dictionary	o Multiscale transform bases o Learned dictionary
Purpose	o To construct learned dictionary
Data	o 3-D spherical data o 3-D sparse representations
Image	Image structures o Image textures o Image edges o Image details o Line structures
Task	o Morphological diversity

Chapter Three - 3-D Sparse Representations	Advances in Imaging and Electron Physics, 183(2014) 99-204, doi.org/10.1016/B978-0-12-800265-0.00003-5
Francois Lanusse and Jean-Luc Starck and Arnaud Woiselle and M.JalalFadili	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Multiscale transform bases	o Ridgelet o Digital Radon transforms	o **Task**	Image o Compression o Reconstruction o De-noising
Reconstruction	Transformed into convex optimization problem **ObjFn:** Minimum Total Variation **Constraint:** Coefficients of the unknown object and Coefficients of training data do not have largedifference		

New multiscale transforms, minimum total variation synthesis: applications to edge-preserving image reconstruction	Signal Processing, 82(2002)1519-1543, doi.org/10.1016/S0165-1684(02)00300-6
Emmanuel J. Candès and Franck Guo	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Data	o Natural images
Task	o Reconstructionon overcomplete dictionary
Method	Collaborative compressed sensing (CS) Sharing similar structures; Nonlocal self-similarity models: sparse model + autoregressive model
Purpose	To enhance the accuracy and stability in recovering the sparse representations of image blocks
FOM	+ This method outperforms reconstruction methods without collaborations

Compressed sensing by collaborative reconstruction on over complete dictionary	Signal Processing, 103(2014) 92-102, doi.org/10.1016/j.sigpro.2013.11.039
Leping Lin and Fang Liu and Licheng Jiao	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Multiscale transform bases	o Finite ridgelet
Task	o Image watermarking
Method	Robust spread spectrum

A robust spread spectrum based image watermarking in ridgelet domain	AEU-International Journal of Electronics and Communications, 66(2012)364-371, doi.org/10.1016/j.aeue.2011.09.001
HamidrezaSadreazami and Marzieh Amini	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Multiscale transform bases	o Ridgelet	
Data	o Image	o Fingerprint
Task	o Image watermarking	
Method	Wave atoms based compression method	
Purpose	Fingerprint compression	
FOM	Wave atom transform more appropriate compared to wavelets for fingerprint image compression	
Inspiration	+ Human visual system	

Wave atoms based compression method for fingerprint images	Pattern Recognition, 46(2013)2450-2464, doi.org/10.1016/j.patcog.2013.02.004
Zehira Haddad and AzeddineBeghdadi and Amina Serir and Anissa Mokraoui	

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The framework of P systems applied to solve optimal watermarking problem	Signal Processing, 101(2014)256-265, doi.org/10.1016/j.sigpro.2014.02.020
Hong Peng and Jun Wang and Mario J. Pérez-Jiménez and AgustínRiscos-Núñez	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet—Ridgelet—

Multiscale transform bases	Finite ridgelet transform
Purpose	For better preservation of directional singularities
Task	Image denoising Patch basedvisual quality improvement

Patch based image denoising using the finite ridgelet transform for less artifacts	Journal of Visual Communication and Image Representation, 25(2014)1006-1017, doi.org/10.1016/j.jvcir.2014.02.018
Yun-Xia Liu and Ngai-Fong Law and Wan Chi Siu	

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Multiscale transform bases	Ridgelets	
Model. proposed	✓ Integrated Curvelet-based image retrieval scheme	
Task	▶ Dominant colors extraction Texture analysis	
DataSets	o Image	Content-based

ICTEDCT-CBIR: Integrating curvelet transform with enhanced dominant colors extraction and texture analysis for efficient content-based image retrieval	Computers & Electrical Engineering, 38(2012)1358-1376, doi.or6g/10.1016/j.compeleceng.2012.05.010
Sherin M. Youssef	

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Energy-based adaptive transform scheme in the DPRT domain and its application to image denoising	Signal Processing, 89(2009)31-41, doi.org/10.1016/j.sigpro.2008.07.012
Yun-Xia Liu and Yu-Hua Peng and Wan-Chi Siu	

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Ridgelet-85	
Intelligent nonconvex compressive sensing using prior information for image reconstruction by sparse representation	Neurocomputing, 224(2017)71-81, doi.org/10.1016/j.neucom.2016.10.051
Qiang Wang and Dan Li and Yi Shen	

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Remote sensing image fusion using the curvelet transform	Information Fusion, 8(2007)143-156, doi.org/10.1016/j.inffus.2006.02.001

Filippo Nencini and Andrea Garzelli and Stefano Baronti and Luciano Alparone	

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A color image steganography in hybrid FRT–DWT domain	Journal of Information Security and Applications, 40(2018)92-102, doi.org/10.1016/j.jisa.2018.03.004
Rohit Thanki and Surekha Borra	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet—Ridgelet—

Agriculture

Multiscale transform bases	Curvelet transform
Discipline	Agriculture
Output	🕮 Explicit information at different scales and directions → variability in landscape processes in the study area 🕮 Scale specific prediction of soil properties 🕮 Filtering, smoothing and denoising of satellite derived data
Appln	o Anisotropic soil spatial variation

Curvelet transform to study scale-dependent anisotropic soil spatial variation	Geoderma,213(2014)589-599, doi.org/10.1016/j.geoderma.2013.07.029
Asim Biswas and Hamish P. Cresswell and Raphael A. ViscarraRossel and Bing C. Si	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet—Ridgelet—

Wind power

Multiscale transform bases	o Ridgelet transforms, o Hybrid feature selection o Closed-loop forecasting	
Task	o Wind power	o Prediction
Work flow	**Feature selection**: Output of ridgelet transform → Input of new feature selection method→ Identify best candidates for forecast engine input→ Hybrid closed loop forecast engine → Neural network + intelligent algorithm → Predict the wind signal	

A new wind power prediction method based on ridgelet transforms, hybrid feature selection and closed-loop forecasting	Advanced Engineering Informatics, 36(2018)20-30, doi.org/10.1016/j.aei.2018.02.006
Hua Leng and Xinran Li and Jiran Zhu and Haiguo Tang and Zhidan Zhang and NoradinGhadimi	

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Multiscale transform bases	Ridgelets
Task	▶ Contactless hand tracking ▶ Contactless palm print and knuckle print recognition system
Phase 2	▶ Scores from palm print and knuckle print fused using support vector machine. → ▶ Promising output for practical systems

An innovative contactless palm print and knuckle print recognition system	Pattern Recognition Letters, 31(2010)1708-1719, doi.org/10.1016/j.patrec.2010.05.021
Goh Kah Ong Michael and Tee Connie and Andrew Teoh BengJin	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Multiscale transform bases	k-plane ridgelet transforms
Method.proposed:	Convolution–backprojection method for k-plane Radon transform
Applications	🕮 Modification of this method → 🕮 Explicit inversion formula for wavelet-like transforms (or k-plane ridgelet transforms) 🕮 Generalization of Calderón's reproducing formula

Convolution–backprojection method for the k-plane transform, and Calderón's identity for ridgelet transforms	Applied and Computational Harmonic Analysis, 16(2004)231-242, doi.org/10.1016/j.acha.2004.03.003
Boris Rubin	

Ridgelet—Ridgelet--Ridgelet—Ridgelet--Ridgelet—Ridgelet--Ridgelet—Ridgelet--Ridgelet—

Method	o Ridgelet transform (RT) o Gabor wavelet transform (GWT)
Unique.properties	Property / Tranform ✓ Scale and rotation invariant — Gabor wavelet ✓ Orientation dependent — Ridgelet
Task	Recognition of human activity in a video sequence

Human Activity Recognition Using Gabor Wavelet Transform and Ridgelet Transform	Procedia Computer Science, 57(2015)630-363, doi.org/10.1016/j.procs.2015.07.425
D.K. Vishwakarma and Prachi Rawat and Rajiv Kapoor	

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Method	🕮 Ridgelet transform regularization
Applicable to	✓ Improvement for antibiotics component analysis ✓ Depth IR spectroscopic data

	resolution

Depth IR spectroscopic data resolution improvement for antibiotics component analysis in critically ill elderly patients	Infrared Physics & Technology, 93(2018)291-299, doi.org/10.1016/j.infrared.2018.06.030
Qiuxia Liu and Zhenhui Guo and Sha Xiao and Haiyang Yu	

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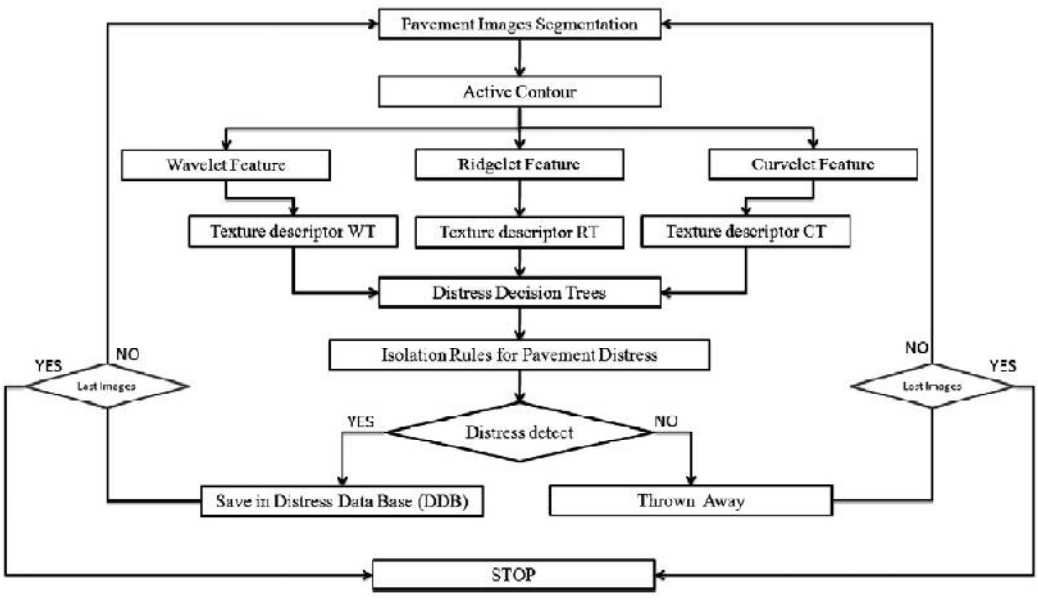
Multiscale transform bases	Ridgelet	
Task	asphalt pavement distress	
	distress detection and isolation	automated imaging system
Procedure	1) Image collection 2) Segmentation of regions of interest 3) Extraction of most discriminative texture features 4) Creation of a classifier → automatically identifies the pavement distress	
FOM	Ridgelet accuracy rates 93.6–96.4% rate Curvelet 97.9%.	



Flow of Methodology modules

A comparison of multi-resolution methods for detection and isolation of pavement distress	Expert Systems with Applications, 38(2011)2857-2872, doi.org/10.1016/j.eswa.2010.08.079
FereidoonMoghadasNejad and HamzehZakeri	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Multiscale transform bases	✓ Geometrical multi-resolution network (GMN)	FNN : Three-ayer **Activation function**: Ridgelet

Applicable to	✓ Function approximation

Geometrical multi-resolution network based on ridgelet frame	Signal Processing,87(2007)750-761, doi.org/10.1016/j.sigpro.2006.07.009
Shuyuan Yang and Min Wang and Licheng Jiao	

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Automatic ridgelet image enhancement algorithm for road crack image based on fuzzy entropy and fuzzy divergence	Optics and Lasers in Engineering, 47(2009)1216-1225, doi.org/10.1016/j.optlaseng.2009.05.014
Daqi Zhang and Shiru Qu and Li He and Shuang Shi	

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Short-term wind power forecasting using ridgelet neural network	Electric Power Systems Research, 81(2011)2099-2107, doi.org/10.1016/j.epsr.2011.08.007
NimaAmjady and FarshidKeynia and HamidrezaZareipour	

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Application of multi-resolution analysis in sonar image denoising	Journal of Systems Engineering and Electronics, 19(2008)1082-1089, doi.org/10.1016/S1004-4132(08)60201-7
Shang Zhengguo and Zhao Chunhui and Wan Jian	

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Digital Ridgelet Transform Based on True Ridge Functions	Beyond Wavelets,10(2003)1-30, doi.org/10.1016/S1570-579X(03)80029-0
D.L. Donoho and A.G. Flesia	

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A novel linear ridgelet network approach for analog fault diagnosis using wavelet-based fractal analysis and kernel PCA as preprocessors	Measurement, 45(2012)297-310, doi.org/10.1016/j.measurement.2011.11.018
Yingqun Xiao and Lianggui Feng	

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A linear ridgelet network	Neurocomputing, 73(2009)468-477, doi.org/10.1016/j.neucom.2009.07.006
Shuyuan Yang and Min Wang and Licheng Jiao	

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A new use of the ridgelets transform for describing linear singularities in images	Pattern Recognition Letters, 27(2006)587-596, doi.org/10.1016/j.patrec.2005.09.024
O. Ramos Terrades and E. Valveny	

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Ridge Functions and Orthonormal Ridgelets	Journal of Approximation Theory, 111(2001)143-179, doi.org/10.1006/jath.2001.3568
David L Donoho	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Optimal adaptive ridgelet schemes for linear advection equations	Applied and Computational Harmonic Analysis, 41(2016)768-814, doi.org/10.1016/j.acha.2015.06.003
Philipp Grohs and Axel Obermeier	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Image denoising with complex ridgelets	Pattern Recognition, 40(2007)578-585, doi.org/10.1016/j.patcog.2006.04.039
G.Y. Chen and B. Kégl	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Medical image denoising using multi-resolution transforms	Measurement, 145(2019)769-778, doi.org/10.1016/j.measurement.2019.01.001
J. Relin Francis Raj and K. Vijayalakshmi and S. Kavi Priya	

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Identification of deep magnetized structures in the tectonically active Chlef area (Algeria) from aeromagnetic data using wavelet and ridgelet transforms	Journal of Applied Geophysics, 154(2018)167-181, doi.org/10.1016/j.jappgeo.2018.04.026
H. Boukerbout and A. Abtout and D. Gibert and B. Henry and B. Bouyahiaoui and M.E.M. Derder	

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Adaptive digital ridgelet transform and its application in image denoising	Digital Signal Processing, 52(2016)45-54, doi.org/10.1016/j.dsp.2016.02.004
Qiangui Huang and Boya Hao and Sheng Chang	

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Curvelets and Curvilinear Integrals	Journal of Approximation Theory, 113(2001)59-90, doi.org/10.1006/jath.2001.3624
Emmanuel J. Candès and David L. Donoho	

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Rotation invariant texture classification by ridgelet transform and frequency–orientation space decomposition	Signal Processing, 88(2008)189-199, doi.org/10.1016/j.sigpro.2007.07.019
Wumo Pan and T.D. Bui and C.Y. Suen	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet

Frosting weight and refrigerating capacity prediction of fin evaporator based on random finite element method and ridgelet neural network	International Journal of Refrigeration, 99(2019)37-46, doi.org/10.1016/j.ijrefrig.2018.11.046
Zhao Bin and Yi Ren and Gao Diankui and Shi Chengjiang and Xu Lizhi and Zhang Yuanyuan	

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α-Molecules	Applied and Computational Harmonic Analysis, 41(2016)297-336, doi.org/10.1016/j.acha.2015.10.009
Philipp Grohs and Sandra Keiper and Gitta Kutyniok and Martin Schäfer	

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Distributed compressed sensing-based pan-sharpening with hybrid dictionary	Neurocomputing, 155(2015)320-333, doi.org/10.1016/j.neucom.2014.11.054
Wenqing Wang and Licheng Jiao and Shuyuan Yang and Kaixuan Rong	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Linear feature extraction based on complex ridgelet transform	Wear, 264(2008)428-433, doi.org/10.1016/j.wear.2006.08.040
Xiangqian Jiang and Wenhan Zeng and Paul Scott and Jianwei Ma and Liam Blunt	

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Sparse Ridgelet Kernel Regressor and its online sequential extreme learning	Neurocomputing, 134(2014)173-180, doi.org/10.1016/j.neucom.2012.12.066
Shuyuan Yang and Lixia Yang and Zhixi Feng and Min Wang and Licheng Jiao	

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Chapter 9 Approximate Nonlinear Forecasting Methods	Handbook of Economic Forecasting, Elsevier,1(2006) 459 – 512, doi.org/10.1016/S1574-0706(05)01009-8
Halbert White	

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Two stage forecast engine with feature selection technique and improved meta-heuristic algorithm for electricity load forecasting	Energy, 161(2018)130-142,doi.org/10.1016/j.energy.2018.07.088
NoradinGhadimi and Adel Akbarimajd and Hossein Shayeghi and OveisAbedinia	

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Digital Implementation of Ridgelet Packets	Beyond Wavelets, Elsevier, 10(2003)31-60, doi.org/10.1016/S1570-579X(03)80030-7
A.G. Flesia and H. Hel-Or and A. Averbuch and E.J. Candès and R.R. Coifman and D.L. Donoho	

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Ridgelet bi-frame	Applied and Computational Harmonic Analysis, 20(2006)391-402, doi.org/10.1016/j.acha.2005.10.004
Shan Tan and Licheng Jiao	

Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—Ridgelet-- Ridgelet—

Directional Hartley transform and content based image retrieval	Signal Processing, 90(2010)1267-1278, doi.org/10.1016/j.sigpro.2009.10.012
P. Rajavel	

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Directional short-time Fourier transform	Journal of Mathematical Analysis and Applications, 399(2013)100-107, doi.org/10.1016/j.jmaa.2012.09.053
Hossein Hosseini Giv	

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Towards multi-scale fuzzy sparse discriminant analysis using local third-order tensor model of face images	Neurocomputing, 185(2016) 53-63, doi.org/10.1016/j.neucom.2015.12.019
Xiaoning Song and Zhen-Hua Feng and Xibei Yang and Xiaojun Wu and Jingyu Yang	

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Chen Ping and Pan Jin-Xiao and Liu Bin	

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