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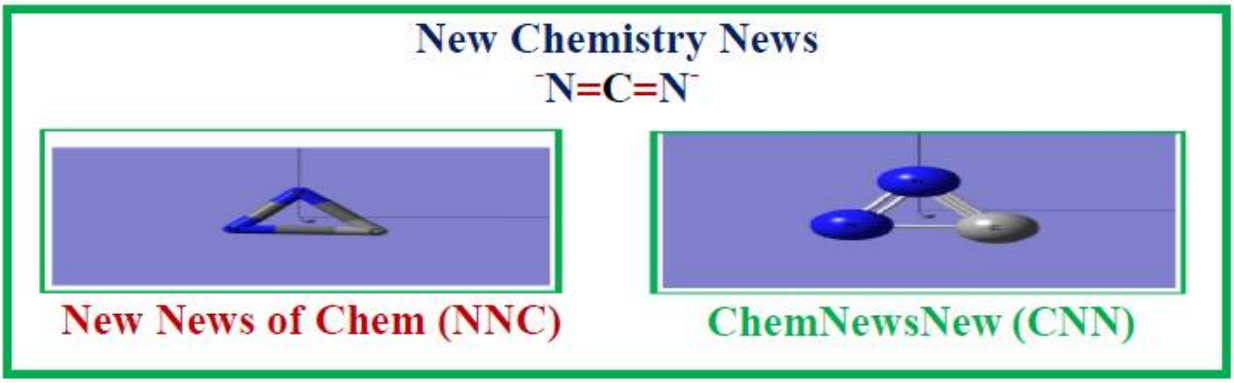

Extreme learning machines (ELM) in Omni_metrics (Om)

SXR – Molecular Descriptors

Predicting refractive index of ionic liquids based on the ELM intelligence algorithm
[MLR + ELM] ; [prediction;1194 refractive index data ; 115 ionic liquids] ; [Mol descriptors → Quantum chemical]

J. of Molecular Liquids, 250, 2018,44-49
doi.org/10.1016/j.molliq.2017.11.166.

Xuejing Kang, Yongsheng Zhao, Jinjin Li,

NOX Emission

Modeling and Optimization of NOX Emission in a Coal-fired Power Plant using Advanced Machine Learning Methods

Energy Procedia, 61, 2014,377-380,
/doi.org/10.1016/j.egypro.2014.11.1129.

Harmony search (HS) + ELM
Optimization of operational parameters: boiler for the control of NOX emissions in a 700 MW pulverized coal-fired power plant

Peng Tan, Ji Xia, Cheng Zhang, Qingyan Fang, Gang Chen, ,

Diagnosis

An efficient hybrid kernel ELM approach for early diagnosis of Parkinson's disease

Neurocomputing, 184, 5 2016,131-144,
doi.org/10.1016/j.neucom.2015.07.138.

Hui-Ling Chen, Gang Wang, Chao Ma, Zhen-Nao Cai, Wen-Bin Liu, Su-Jing Wang,

Performance enhancement of ELM for multi-category sparse data classification problems, Engineering Applications of Artificial Intelligence, 23, Issue 7, 2010,1149-1157, doi.org/10.1016/j.engappai.2010.06.009.

.

- A multi-class human cancer classification using micro-array gene expression data (sparse)

Real-coded GA + ELM

- to select optimal number of hidden neurons, input weights and bias values
- better performance.
- Two new genetic operators
  - network based operator &weight based operator'
- compact network with higher generalization performance

Sparse-ELM

- searches for the best parameters of ELM using K-fold validation.

\

S. Suresh, S. Saraswathi, N. Sundararajan,

Carbon dioxide (CO2) emissions

Prediction of GDP growth rate based on carbon dioxide (CO2) emissions J. of CO2 Utilization, 16, 2016,212-217, doi.org/10.1016/j.jcou.2016.07.009.

ELM: to predict GDP based on CO2 emissions
Comparision: genetic programming (GP); NN

Vladislav Marjanović, Miloš Milovančević, Igor Mladenović, ,

Enhanced combination modeling method for combustion efficiency in coal-fired boilers Applied Soft Computing, Volume 12, Issue 10, 2012, 3132-3140, https://doi.org/10.1016/j.asoc.2012.06.016.

.

ELM : for global model
ANFIS : to compensate the output errors of ELM
to improve the overall performance
PSO + ABC: for better generalization and stability

Guoqiang Li, Peifeng Niu, Chao Liu, Weiping Zhang,

Waste Water Treatment

Enhanced classification based on probabilistic extreme learning machine in wastewater treatment process municipal wastewater treatment plant Procedia Engineering, 15, 2011,5563-5567, doi.org/10.1016/j.proeng.2011.08.1032.

Probabilistic Extreme Learning Machine (Prob ELM) for binary classification
+ P-ELM inhibits uncertainty of ELM prediction in the different trials
Bayesian decision theory: takes into account a priori probability of the process & uncertainty of the ELM predictions

L.J. Zhao, X.K. Diao, D.C. Yuan, W. Tang

WW- Quality

KPCA and ELM ensemble modeling of wastewater effluent quality indices prediction	Procedia Engineering, 15, 2011,5558-5562, doi.org/10.1016/j.proeng.2011.08.1031.

kernel PCA + ELM embedded into ensemble frame
effluent quality prediction
KPCA: extracts nonlinear feature of input space
+ overcomes high dimension and collinearity

L.J. Zhao, D.C. Yuan, T.Y. Chai, J. Tang,

Rule extraction

A new method for constructing granular neural networks based on rule extraction and ELM	Pattern Recognition Letters, 67, Part 2, 1 2015,138-144, doi.org/10.1016/j.patrec.2015.05.006.

Granular neural networks

- Algorithms of attributes reduction: Sample data are reduced
- Rough set theory: attributes values reduction
- Compressed to an irredundant data set
- Each sample represents a rough rule (If-Then rule) relationship between the input and output pattern
- Granular-neurons constructed through the If-Then rules,
- All granular-neurons constitute rule matching layer It is regarded as the hidden layer of the RRGELM
- Linked weights between the input neurons and granular-neurons determined by the confidences of rough decision rules,
- Linked weights between the output neurons and granular-neurons initialized as the contributions of the rough rules to the classification.
- ELM alg improves learning speed of the RRGELM (better than BP alg)

Granular neural networks are formed on the basis of rough decision rules extracted from training samples through rough set theory

Xinzheng Xu, Guanying Wang, Shifei Ding, Xiangying Jiang, Zuopeng Zhao,

Pattern recognition

Evolutionary ELM, Pattern Recognition Differential Evol Alg → To select the input weights Moore–Penrose generalized inverse → analytical determination of output weights.	38, Issue 10, 2005,1759-1763, doi.org/10.1016/j.patcog.2005.03.028.

Qin-Yu Zhu, A.K. Qin, P.N. Suganthan, Guang-Bin Huang

[German; Belgium] Traffic Sign Recognition Based On Multi-feature Fusion and ELM Classifier	Procedia Computer Sci., 127, 2018,146-153, doi.org/10.1016/j.procs.2018.01.109.

Saouli Aziz, El Aroussi Mohamed, Fakhri Youssef

GPU-Accelerated ELM for Imbalanced Data Streams with Concept Drift	Procedia Computer Sci., 80, 2016,1692-1701, doi.org/10.1016/j.procs.2016.05.509
Bartosz Krawczyk, ,	

Time series	
Vehicle speed prediction via a sliding-window time series analysis and an evolutionary least learning machine: A case study on San Francisco urban roads Compared with: AR, MLP-NN-BP, evolutionary ELM; RBFNN	Engineering Sci. and Technology, an Int. J., 18, Issue 2, 2015,150-162, doi.org/10.1016/j.jestch.2014.11.002
Ladan Mozaffari, Ahmad Mozaffari, Nasser L. Azad, ,	

Short-term load forecasting	
A switching delayed PSO optimized ELM for short-term load forecasting, Optimization: input weights and biases of ELM	Neurocomputing, 240, 31 2017,175-182, doi.org/10.1016/j.neucom.2017.01.090.
Nianyin Zeng, Hong Zhang, Weibo Liu, Jinling Liang, Fuad E. Alsaadi,	

Hybrid-ELM

Coral Reefs + ELM

Daily global solar radiation prediction based on a hybrid Coral Reefs Optimization – ELM approach

Solar Energy, 105, 2014,91-98, doi.org/10.1016/j.solener.2014.04.009

ELM : solves prediction problem
CRO: evolves the weights of NN

S. Salcedo-Sanz, C. Casanova-Mateo, A. Pastor-Sánchez, M. Sánchez-Girón, ,.

Feature selection in wind speed prediction systems based on a hybrid coral reefs optimization – ELM approach,

Energy Conversion and Management, 87, 2014,10-18, doi.org/10.1016/j.enconman.2014.06.041.

S. Salcedo-Sanz, A. Pastor-Sánchez, L. Prieto, A. Blanco-Aguilera, R. García-Herrera

Type 2 Fuzzy + ELM

A systematic design of interval type-2 fuzzy logic system using ELM for electricity load demand forecasting,

Int. J. of Electrical Power & Energy Systems, Volume 82, 2016, 1-10, https://doi.org/10.1016/j.ijepes.2016.03.001.

IT2FLS + ELM
antecedent membership function parameters of the IT2FLS: randomly generated
consequent part parameters: determined analytically by the Moore–Penrose pseudo inverse

Saima Hassan, Abbas Khosravi, Jafreezal Jaafar, Mojtaba Ahmadieh Khanesar,

A robust combination approach for short-term wind speed forecasting and analysis – Combination of the ARIMA (Autoregressive Integrated Moving Average), ELM, SVM and Least Square SVM → forecasts using a Gaussian Process Regression model,

Energy, Volume 93, Part 1, 15 2015, 41-56, https://doi.org/10.1016/j.energy.2015.08.045. (https://www.Sci.direct.com/Sci./article/pii/S0360544215011202)

probabilistic short-term wind speed forecasting model

Jianzhou Wang, Jianming Hu,

Jordan RecNN + ELM

Forecasting electricity load by a novel recurrent ELMs approach

Int. J. of Electrical Power & Energy Systems, 78, 2016,429-435, , doi.org/10.1016/j.ijepes.2015.12.006. (www.Sci.direct.com/Sci./article/pii/S0142061515005578)

[Jordan RecNN + ELM for training Ws][forecast -- electricity load]

Ömer Faruk Ertugrul

PLSR + ELM

A robust hybrid model integrating enhanced inputs based ELM with PLSR and its application to intelligent measurement

ISA Transactions, 58, 2015,533-542, doi.org/10.1016/j.isatra.2015.06.007.

ELM

- intractable problem in determining the optimal number of the hidden layer neurons
- over-fitting phenomenon.
- Remedy: PLSR-EIELM

Alg

- Traditional ELM (ELM) selected
- Assign random weights between the input hidden layer
- Nonlinear transformation for independent variables obtained from the output of the hidden layer neurons

Yan-Lin He, Zhi-Qiang Geng, Yuan Xu, Qun-Xiong Zhu

Harmony search + ELM

A hybrid intelligent model for medium-term sales forecasting in fashion retail supply chains using ELM and harmony search algorithm

Int. J. of Production Economics, 128, Issue 2, December 2010,614-624, doi.org/10.1016/j.ijpe.2010.07.008.

Learning alg.: Improved harmony search Alg. + ELM

+ improve generalization performance

W.K. Wong, Z.X. Guo,

A self adaptive differential harmony search based optimized ELM for financial time series prediction

Swarm and Evolutionary Computation, Volume 19, 2014, 25-42, https://doi.org/10.1016/j.swevo.2014.07.003.

Task: Prediction of closing price and volatility of stock indices

- Self Adaptive Differential Harmony Search (SADHS): uses the current to best mutation scheme of DE in the pitch adjustment operation for harmony improvisation process.
- Applied for: optimal selection of the hidden layer parameters, the bias of neurons of the hidden-layer, regularization factor of robust least squares,
- ELM : to obtain the output weights analytically using a robust least squares solution
- SADHS+ ELM: applied for two SLP-NNs i.e. RBF and a low complexity Functional link NN for prediction
- SLP-NN
- Compared with: ELM, DE-OELM, DE, SADHS

Rajashree Dash, P.K. Dash, Ranjeeta Bisoi

Multi-level hybrid support vector machine and ELM based on modified K-means for intrusion detection system

Expert Systems with Applications, Volume 67, 2017, 296-303, https://doi.org/10.1016/j.eswa.2016.09.041.

.

A modified K-means algorithm : to build a high-quality training dataset that contributes significantly to improving the performance of classifiers

Wathiq Laftah Al-Yaseen, Zulaiha Ali Othman, Mohd Zakree Ahmad Nazri,

Honey bee foraging + ELM

Tuning ELM by an improved artificial bee colony to model and optimize the boiler efficiency

Knowledge-Based Systems, 67, 2014,278-289, doi.org/10.1016/j.knosys.2014.04.042

Artificial bee colony algorithm

- opposition-based learning applied to population initialization
- greedy selection mechanism is not adopted
- mode that employed bees become scouts is modified

Guoqiang Li, Peifeng Niu, Yunpeng Ma, Hongbin Wang, Weiping Zhang,

Wavelet + ELM

Short-term load forecasting by wavelet transform and evolutionary ELM

Electric Power Systems Research, 122, 2015,96-103, , doi.org/10.1016/j.epsr.2015.01.002.

wavelet transform

ELM + modified artificial bee colony alg

Compared : conventional neuro-evolution method

Song Li, Peng Wang, Lalit Goel,

Wolf optimization + ELM

Grey wolf optimization evolving kernel ELM: Application to bankruptcy prediction

Eng. Applications of Artificial Intelligence, 63, 2017,54-68 doi.org/10.1016/j.engappai.2017.05.003.

kernel ELM—
grey wolf optimization
PSO-based KELM,
GA-based KELM
grid-search based KELM,
improved ELM, SVM, random forest

Mingjing Wang, Huiling Chen, Huaizhong Li, Zhennao Cai, Xuehua Zhao, Changfei Tong, Jun Li, Xin Xu,

MARS + ELM

Estimating heating load in buildings using multivariate adaptive regression splines, ELM, a hybrid model of MARS and ELM

Renewable and Sustainable Energy Reviews, Volume 82, Part 3, 2018, 4256-4268, https://doi.org/10.1016/j.rser.2017.05.249

Hybrid Alg: MARS + ELM

- MARS (Multivariate Adaptive Regression Splines model)
  - Non-parametric regression model -- splits the data and fits each interval into a basis function
- ELM
  - Similar to a SLP-NN except that in ELM randomly assigned input weights are not updated

Sanjiban Sekhar Roy, Reetika Roy, Valentina E. Balas,
GA + ELM

Genetic ensemble of ELM

Neurocomputing, 129, 10 2014,175-184, doi.org/10.1016/j.neucom.2013.09.042.

GA + ELM

+ generate more robust networks with better generalization performance

GA: produces a group of candidate networks

- Some of the networks are selected to ensemble a new network according to a specific ranking strategy
- compared with
  - canonical ELM, E-ELM, simple ensemble, EE-ELM, EN-ELM, Bagging and Adaboost

Xiaowei Xue, Min Yao, Zhaohui Wu, Jianhua Yang,

PSO + ELM

An improved evolutionary ELM based on particle swarm optimization

Neurocomputing, 116, 2013,87-93, doi.org/10.1016/j.neucom.2011.12.062.

PSO: to select the input weights and hidden biases
Moore–Penrose generalized inverse :to analytically determine the output weights

Investigating the use of alternative topologies on performance of the PSO-ELM

Neurocomputing, Volume 127, 2014, 4-12, https://doi.org/10.1016/j.neucom.2013.05.047.

PSO uses the Global topology

Elliackin M.N. Figueiredo, Teresa B. Ludermir,

Deep Learning CNN–ELM

A hybrid deep learning CNN–ELM for age and gender classification

Neurocomputing, Volume 275, 31 2018, 448-461, https://doi.org/10.1016/j.neucom.2017.08.062.

Convolutional Neural Network (CNN) and ELM (ELM)

MORPH-II and Adience Benchmark

Mingxing Duan, Kenli Li, Canqun Yang, Keqin Li,

A novel feature selection framework with Hybrid Feature-Scaled ELM (HFS-ELM) for indoor occupancy estimation

Energy and Buildings, 158, 1 2018,1139-1151, doi.org/10.1016/j.enbuild.2017.08.087.

Mustafa K. Masood, Chaoyang Jiang, Yeng Chai Soh,

Robust total energy demand estimation with a hybrid Variable Neighborhood Search – ELM algorithm

Energy Conversion and Management, 123, 1 2016,445-452, doi.org/10.1016/j.enconman.2016.06.050.

Variable Neighborhood Search + ELM

VNS: extracts most relevant features

J. Sánchez-Oro, A. Duarte, S. Salcedo-Sanz,

Rough set + ELM

A hybrid decision support system based on rough set and ELM for diagnosis of hepatitis disease

Applied Soft Computing, Volume 13, Issue 8, 2013, 3429-3438, https://doi.org/10.1016/j.asoc.2013.03.008.

rough set + ELM

Hepatitis data

Yılmaz Kaya, Murat Uyar

Hierarchical ELM

ELM towards dynamic model hypothesis in fish ethology research

Neurocomputing, 128, 27 2014,273-284, doi.org/10.1016/j.neucom.2013.03.054.

hierarchical hybrid ELM ensemble combines individual SLFN

color distribution and the appearance recognition, from SLP-NN at diverse levels with ELM

Rui Nian, Bo He, Bing Zheng, Mark van Heeswijk, Qi Yu, Yoan Miche, Amaury Lendasse,

A hierarchical structure of ELM (HELM) for high-dimensional datasets with noise

Neurocomputing, 128, 2014,407-414 doi.org/10.1016/j.neucom.2013.08.024.

HELM

Subnets: based on some well-trained auto-associative NNs

AANNs: reduces dimension ; filter out noise

main net: based on traditional ELM

Data Attributes Extension Classification

Datasets: five high-dimensional datasets with noise

Yan-Lin He, Zhi-Qiang Geng, Yuan Xu, Qun-Xiong Zhu,

Classification

Integrating Data Selection and Extreme Learning Machine for Imbalanced Data — Procedia Computer Sci., 59, 2015,221-229, doi.org/10.1016/j.procs.2015.07.561.

[data selection + ELM]; [UCI-MLR Data Sets: 13 Highly Imbalanced Binary Classification;]

Umi Mahdiyah, M. Isa Irawan, Elly Matul Imah,

Classification Based on Multilayer Extreme Learning Machine for Motor Imagery Task from EEG Signals, — , Procedia Computer Sci., 88, 2016,176-184, doi.org/10.1016/j.procs.2016.07.422

Lijuan Duan, Menghu Bao, Jun Miao, Yanhui Xu, Juncheng Chen

Hybrid approach using fuzzy sets and extreme learning machine for classifying clinical datasets — Informatics in Med. Unlocked, 2, 2016,1-11, doi.org/10.1016/j.imu.2016.01.001

University of California Irvine (UCI) Data sets:
[Cleveland heart disease (CHD), Statlog heart disease (SHD);Pima Indian diabetes (PID) datasets]
Preprocessing subsystem: [Missing value imputation + outlier]
Fuzzification: [maps each feature to a fuzzyset]
Classification subsystem: [ELM]

Kindie Biredagn Nahato, Khanna H. Nehemiah, A. Kannan

Cloud image

A hybrid method based on ELM and k-nearest neighbor for cloud classification of ground-based visible cloud image — Neurocomputing, 160, 21 2015,238-249, doi.org/10.1016/j.neucom.2015.02.022.

classification scheme based on ELM and k nearest neighbor is proposed for cloud classification
outperforms ELM (ELM) models, artificial neural network (ANN), k-nearest neighbor (KNN), hybrid method based on KNN and ANN (KNN – ANN), and support vector machine (SVM).

Min Xia, Weitao Lu, Jun Yang, Ying Ma, Wen Yao, Zichen Zheng,

ELM and adaptive sparse representation for image classification — Neural Networks, 81, 2016,91-102, doi.org/10.1016/j.neunet.2016.06.001.

sparse representation classification

- time-consuming

ELM

- less robust to noise

Jiuwen Cao, Kai Zhang, Minxia Luo, Chun Yin, Xiaoping Lai,

Vehicle classification

Hybridizing ELMs and Genetic Algorithms to select acoustic features in vehicle classification applications — Neurocomputing, 152, 25 2015,58-68, doi.org/10.1016/j.neucom.2014.11.019.

E. Alexandre, L. Cuadra, S. Salcedo-Sanz, A. Pastor-Sánchez, C. Casanova-Mateo,

A hybrid approach combining ELM and sparse representation for image classification

Engineering Applications of Artificial Intelligence, 27, 2014,228-235, , doi.org/10.1016/j.engappai.2013.05.012.

- Handwritten digit classification
- Face recognition

Minxia Luo, Kai Zhang,

An integrated PSO for parameter determination and feature selection of ELM and its application in classification of power system disturbances

Applied Soft Computing, 32, 2015,23-37, , doi.org/10.1016/j.asoc.2015.03.036

discrete-valued PSO + continuous-valued PSO:

- To optimize the input feature subset selection and the number of hidden nodes
- To enhance the performance of ELM

R. Ahila, V. Sadasivam, K. Manimala,

Performance enhancement of ELM for multi-category sparse data classification problems,

Engineering Applications of Artificial Intelligence, 23, Issue 7, 2010,1149-1157, doi.org/10.1016/j.engappai.2010.06.009.

.

- A multi-class human cancer classification using micro-array gene expression data (sparse)

Real-coded GA + ELM

- to select optimal number of hidden neurons, input weights and bias values
- better performance.
- Two new genetic operators
  - network based operator &weight based operator'
- compact network with higher generalization performance

Sparse-ELM

- searches for the best parameters of ELM using K-fold validation.

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S. Suresh, S. Saraswathi, N. Sundararajan,

Media Content Analysis

Regularized Extreme Learning Machine for Large-scale Media Content Analysis

Procedia Computer Sci., 53, 2015,420-427, doi.org/10.1016/j.procs.2015.07.319.

[Regularization + ELM]
used for [training SLP-NN; face recognition; motor imagery EEG]
[feature extraction: PCA and LDA
Classification: Multilayer ELM]
compared with: [kernel-ELM, Constrained-ELM; V-ELM]

Alexandros Iosifidis, Anastasios Tefas, Ioannis Pitas,

Fault diagnosis

An Intelligent Fault Diagnosis Approach for PV (photovoltaic) Array Based on SA-RBF Kernel Extreme Learning Machine

Energy Procedia, 105, 2017,1070-1076, doi.org/10.1016/j.egypro.2017.03.462.

Fault diagnosis ; Improved RBF kernel ELM + optimized sim annealing alg,

Yue Wu, Zhicong Chen, Lijun Wu, Peijie Lin, Shuying Cheng, Peimin Lu,

Streamflow-forecast

Multi-station streamflow forecasting using wavelet denoising and artificial intelligence models — Procedia Computer Sci., 120, 2017,617-624, doi.org/10.1016/j.procs.2017.11.287.

threshold based wavelet denoising + ELM + LSSVM
forecast Snoqualmie watershed daily Multi-Station streamflow

Vahid Nourani, Gholamreza Andalib, Fahreddin Sadikoglu, ,

Multi-station streamflow forecasting using wavelet denoising and artificial intelligence models — Procedia Computer Sci., 120, 2017, 617-624, https://doi.org/10.1016/j.procs.2017.11.287.

wavelet denoising with ELM + LS-SVM

Vahid Nourani, Gholamreza Andalib, Fahreddin Sadikoglu,

Aquaculture

A hybrid model for dissolved oxygen prediction in aquaculture based on multi-scale features, — Information Processing in Agriculture, 5, Issue 1, 2018,11-20, , doi.org/10.1016/j.inpa.2017.11.002.

Prediction accuracy of dissolved oxygen

- Ensemble empirical mode decomposition: original dissolved oxygen datasets are decomposed by EEMD → # components
- Reconstruction of high frequency term, intermediate frequency term, low frequency term and trend term with these components.
- ? Prediction:
- least squares SVR: to predict high and intermediate frequency terms, (which fluctuate violently)
- MLP-NN-BP + optimal mind evolutionary computation: The fluctuation of low frequency term is gentle and periodic,
- grey model: trend term (nearly linear)

Chen Li, Zhenbo Li, Jing Wu, Ling Zhu, Jun Yue,

Commerce

Fashion retailing forecasting based on ELM with adaptive metrics of inputs — Knowledge-Based Systems, 36, 2012,253-259, doi.org/10.1016/j.knosys.2012.07.002.

Outperforms AR, NN, ELM

Min Xia, Yingchao Zhang, Liguo Weng, Xiaoling Ye,

Volatility forecasting for interbank offered rate using grey ELM: The case of China, — Chaos, Solitons & Fractals, 89, 2016,249-254, doi.org/10.1016/j.chaos.2015.11.033.

Alg:

- Grey model: deals with original IBOR time series accumulated generating operation (AGO)
- ELM to analyze the new IBOR series.
- Inverse accumulated generating operation: predictive value of original IBOR

Xiaoyong Liu, Hui Fu,

Forex

A hybridized ELM-Jaya forecasting model for currency exchange prediction

J. of King Saud University - Computer and Information Sci., Available online 21 2017, doi.org/10.1016/j.jksuci.2017.09.006

US Dollar; Indian Rupee
compared with : optimized NN; Functional Link NN

Smruti Rekha Das, Debahuti Mishra, Minakhi Rout

Data decomposition based fast reduced kernel ELM for currency exchange rate forecasting and trend analysis

Expert Systems with Applications, 96, 15 2018,427-449, doi.org/10.1016/j.eswa.2017.10.053

forecasting exchange rate foreign currency one day ahead

Empirical Mode Decomposition (EMD) + kernel ELM
EMD : efficient method for nonlinear data decomposition & to find important components in terms of Intrinsic Mode Functions (IMFs)
nonlinear time series converted into stationary time series

+ data becomes smoother and simpler for analysis

average IMFs decomposed from EMD (AEMD) are hybridized with fast KELM

+ accurate forecast

P.P. Das, R. Bisoi, P.K. Dash,

Wind speed forecasting

Wind speed forecasting method using wavelet, ELM and outlier correction algorithm, Energy Conversion and Management

151, 1 2017,709-722, doi.org/10.1016/j.enconman.2017.09.034.

- Wind speed forecasting multi-step
  - Wavelet Domain Denoising, Wavelet Packet Decomposition, Empirical Mode Decomposition, Auto Regressive Moving Average,
  - ELM, Outlier Correction Method

Xi-wei Mi, Hui Liu, Yan-fei Li,

Smart wind speed forecasting using EWT decomposition, GWO evolutionary optimization, RELM learning and IEWT reconstruction

Energy Conversion and Management, 161, 1 2018, 266-283, https://doi.org/10.1016/j.enconman.2018.02.006.

Alg: hybrid EWT-GWO-IEWT

- ✓ EWT (Empirical Wavelet Transform) decomposition: To decompose the raw series into several wind speed subseries adaptively;
- ✓ Regularized ELM NN- optimized by GWO: forecast each subseries;
- ✓ Inverse EWT: to reconstruct the forecasted results to avoid the unexpected forecasting values.
- \+ IEWT is effective in improving the accuracy and stability of the prediction;
- \+ GWO improves the forecasting performance of the proposed hybrid EWT-RELM-IEWT structure significantly
- \+ performance of the RELM network is better than that of the SVM (Support Vector Machine) in the proposed structure; involved forecasting models,
- \+ the proposed hybrid model has the best multiple step prediction performance

Hui Liu, Haiping Wu, Yanfei Li

An effective secondary decomposition approach for wind power forecasting using ELM trained by crisscross optimization, — Energy Conversion and Management, 150, 15 2017,108-121, doi.org/10.1016/j.enconman.2017.08.014.

Hao Yin, Zhen Dong, Yunlong Chen, Jiafei Ge, Loi Lei Lai, Alfredo Vaccaro, Anbo Meng,

Three-Dimensional Local Energy-Based Shape Histogram (3D-LESH)-Based Feature Extraction– A Novel Technique — Expert Systems with Applications, Available online 5 2017 doi.org/10.1016/j.eswa.2017.11.057.

Detecting breast cancer; MRI images
contrast-limited adaptive histogram equalisation (CLAHE); 3D-LESH features extraction;
subset of these features → SVM ; ELM; n echo state network

Summrina Kanwal Wajid, Amir Hussain, Kaizhu Huang,

The Features Extraction of Infants Cries by Using Discrete Wavelet Transform Techniques — Procedia Computer Sci., 86, 2016,285-288, doi.org/10.1016/j.procs.2016.05.073

infant sound features extraction
Haar wavelet + ELM

Anyawee Chaiwachiragompol, Nattawoot Suwannata,

Complex ELM applications in terahertz pulsed signals feature sets — Computer Methods and Programs in Biomedicine, 117, Issue 2, 2014,387-403, doi.org/10.1016/j.cmpb.2014.06.002.

X.-X. Yin, S. Hadjiloucas, Y. Zhang,

Determination of rock depth using artificial intelligence techniques — GeoSci. Frontiers, 7, Issue 1, 2016,61-66, doi.org/10.1016/j.gsf.2015.04.002

Gaussian Process Regression (GPR), Least Square SVM ; ELM
prediction of rock depth (d) at any point in Chennai

R. Viswanathan, Pijush Samui,.

ELM for single-output regression problems

Neurocomputing, 72, 13–15, 2009,3066-3076, doi.org/10.1016/j.neucom.2009.03.016.

partial Lanczos ELM (PL-ELM) which employs the hybrid of Output weights computation.: partial Lanczos bidiagonalization + SVD

PL-ELM

+ Improves stability
+ Generalization performance
+ Increased learning speed

Xiaoliang Tang, Min Han, Partial Lanczos

Ordinal ELM

Neurocomputing, 74, 1–3, 2010,447-456,

single multi-output classifier, multiple binary-classifications

doi.org/10.1016/j.neucom.2010.08.022.

one-against-all decomposition method
one-against-one method
Better than:

- Gaussian Process for Ordinal Regression
- (ORGP) SV for Ordinal Regression (ORSVM)

Wan-Yu Deng, Qing-Hua Zheng, Shiguo Lian, Lin Chen, Xin Wang,

Denoising Laplacian multi-layer ELM

Neurocomputing, 171, 1 2016,1066-1074, doi.org/10.1016/j.neucom.2015.07.058

- Semi-supervised ELM (SS-ELM) ; Laplacian smooth twin SVM;
- ELM based auto encoder : to create a multi-layer neural network.
- ML-ELM
  - approximates the complicated function
  - achieves fast training

Nan Zhang, Shifei Ding, Zhongzhi Shi,

Improvements on parsimonious ELM using recursive orthogonal least squares

Neurocomputing, 191, 2016, 82-94, https://doi.org/10.1016/j.neucom.2016.01.005.

Constructive–destructive alg + ELM; Givens rotation; Householder transformation

Yong-Ping Zhao, Ramón Huerta,

Improvement of the prediction accuracy of polar motion using empirical mode decomposition

Geodesy and Geodynamics, 8, 2, 2017, 141-146, https://doi.org/10.1016/j.geog.2016.09.007.

Empirical mode decomposition

Yu Lei, Hongbing Cai, Danning Zhao,

A fast recognition framework based on ELM using hybrid object information

Neurocomputing, 73, 10–12, 2010,1831-1839, doi.org/10.1016/j.neucom.2009.11.049.

global and local information:bidirectional-2D-PCA ; Ferns style approach

Rashid Minhas, Abdul Adeel Mohammed, Q.M. Jonathan Wu,

Dynamic cost forecasting model based on ELM - A case study in steel plant

Computers & Industrial Engineering, 101, 2016,544-553, doi.org/10.1016/j.cie.2016.09.012.

forecast the cost of iron ore and coking coal
Grey Relation Analysis (GRA) + ELM

Tsung-Yin Ou, Chen-Yang Cheng, Po-Jung Chen, Chayun Perng,

An evolutionary online sequential ELM for maximum power point tracking and control in multi-photovoltaic microgrid system

Renewable Energy Focus, Volume 21, 2017, 33-53, https://doi.org/10.1016/j.ref.2017.08.001

Hybrid Firefly Algorithm (HFA) is used to reduce the randomness in the input weights of the IOSELM. To

Prachitara Satapathy, Snehamoy Dhar, P.K. Dash,

External Fault Classification Experienced by Three-Phase Induction Motor Based on Multi-Class ELM,

Procedia Computer Sci., 70, 2015,814-820, , doi.org/10.1016/j.procs.2015.10.122.

Multi-class ELM (ELM);
MLP

Sandeep Sharma, Hasmat Malik, Ajay Khatri,

Hidden Node Optimization for ELM
PSO

AASRI Procedia, 3, 2012,375-380 doi.org/10.1016/j.aasri.2012.11.059.

Yan-wei Huang, Da-hu Lai

Complex ELM applications in terahertz pulsed signals feature sets

Computer Methods and Programs in Biomedicine, 117, Issue 2, 2014,387-403, doi.org/10.1016/j.cmpb.2014.06.002.

X.-X. Yin, S. Hadjiloucas, Y. Zhang,

Sci.direct.com (SD): Information Source (is)

Select list of binary hybrid ELM algorithms

$$_	
Regularization	ELM
Probabilistic	ELM
Mars	ELM
Rough	ELM
Haar wavelet	ELM
Wavelet	ELM
Fuzzy set	ELM
Jordan NN	ELM
Jaya	ELM

$$_	
Partial Lanczos	ELM
Ordinal	ELM
Regularized	ELM
Svm	ELM
Laplacian	ELM
Adaboost-	ELM
V-elm	ELM
Constrained	ELM
Grey relation analysis	ELM

$$_	
Coral reefs	ELM
Grey wolf	ELM
Artificial bee colony	ELM
Kernal	ELM
PSO-based	ELM
GA-based	ELM
Grid-search based	ELM
Differential Evolutionary	ELM
Harmon y search	ELM
PSO	ELM
Self Adaptive Differential Harmony Search	ELM
Genetic ensemble of	ELM
Granular NN	ELM
Hierarchical structure of	ELM
Constructive–destructive alg +	ELM

Data → Information → Knowledge → Intelligence → Super Intelligence

Intelligence		[{Nature's; Nature mimicking } {Swarm, Human; Artificial};]	
Artificial Intelligence (AI)	[Classical. AI	(AI-1);	1950-1980
	Advanced.AI	(AI-2);	1981-2010
	Humanoid. AI	(AI-3);	2011-2018
	Beyond AI# and nearing nature	HI: Hyper intelligence HAI: Hyper AI or SIVA: Super Int (SI) virtual adaptation(VA)	2020-

Classical AI	:	[senses { vision; hearing; smell, taste}; Speech; } Brain {Theorem proving} ; movement {robotics}]
Advanced Intelligence	:	[Neural nets; self-adaptive systems Computational intelligence; advanced robotics; Nature mimicking algorithms]
Humanoid AI	:	[{Speech; vision; hearing; touch; Taste}; {learning; thinking; Inference} of common man quality]
Beyond	:	[vision {uv; visible; infrared}; Hearing {sonic (20Hz to 20KHz-70KHz (bumble bee; mosquito; Grasshopper; elephant-human-bat)}; Speech { human quality}; conversation {hearing; adaptive speech { Google product_2018} Sensing {dipole, low electric current; magnetic field}

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