

Proceedings of the 2010 IEEE International Conference on Progress in Informatics and Computing

[General Information](#)

[Contents](#)

[Author Index](#)

[Search](#)

[Home](#)

PIC 2010

Proceedings of the 2010
IEEE International Conference on
Progress in Informatics and Computing

December 10-12, 2010, Shanghai, China

Editors:

Yinglin Wang
Yuan Luo

[Home](#)



Proceedings

2010 IEEE International Conference on Progress in Informatics and Computing

Copyright and Reprint Permission: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923. For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Operations Center, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331. All rights reserved. Copyright ©2010 by the Institute of Electrical and Electronics Engineers, Inc.

The papers in this book reflect the authors' opinion and in the interests of timely dissemination, are published as presented and without change. Their inclusion in this publication does not necessarily constitute endorsement by the editors, and the Institute of Electrical and Electronics Engineers, Inc.

Compliant PDF Files

IEEE Catalog Number: CFP1066J-ART

ISBN: 978-1-4244-6789-1

Conference CD-ROM Version

IEEE Catalog Number: CFP1066J-CDR

ISBN: 978-1-4244-6787-7

Print Version

IEEE Catalog Number: CFP1066J-PRT

ISBN: 978-1-4244-6786-0

Proceedings of the 2010

**IEEE International Conference on
Progress in Informatics and Computing**

December 10-12, 2010, Shanghai, China

Sponsors:



IEEE Beijing Section, China



Shanghai Jiao Tong University, China



University of Texas at Dallas



Osaka University, Japan

Committees

General Conference Chairs

Mengqi Zhou, IEEE Beijing Section, China

Yinglin Wang, Shanghai Jiao Tong University, China

Steering Committee Chair

Katsuro Inoue, Osaka University, Japan

Steering Committee Members

Chengfei Liu, Swinburne University of Technology, Australia

Pedro Antunes, University of Lisboa, Portugal

Jiacun Wang, Monmouth University, USA

Gongzhu Hu, Central Michigan University, USA

Du Zhang, California State University, Sacramento, USA

Program Committee Co-Chairs

Yuan Luo, Shanghai Jiao Tong University, China

Xuelong Li, Chinese Academy of Sciences, China

Jyrki Nummenmaa, Tampere University, Finland

Yaoru Sun, Tongji University, China

Publication Chair

Prof. Mengqi Zhou, IEEE Beijing Section, China

Organization Co-Chairs

Jun Dong, Suzhou Institute of Nano-Tech and Nano-Bionics, Chinese Academy of Sciences, China

Michael Sheng, University of Adelaide, Australia

Publicity Chair

Dacheng Tao, Nanyang Technological University, Singapore

Finance Chair

Genzhen Chen, Shanghai Jiao Tong University

TABLE OF CONTENTS

ARTIFICIAL INTELLIGENCE

A Simple Robot Paths Planning Based on Quadtree	1
<i>Fule Wang, Changle Zhou and Hugo.de.Garis</i>	
Simulation Experiment of Continuous Double Auction Stock Market Based on Multi-Agent Model	5
<i>Hongtao Zhou, Jiang Jiang, Wei Zeng, Guangyong Liu and Yi Wang</i>	
Minimizing Influence of Ontology Evolution In Ontology-based Data Access System	10
<i>Funian Tang and Rongnian Tang</i>	
Remotely sensed data processing task scheduling based on limited concentration model	15
<i>Wen Li, Yingwu Chen, Jufang Li and Peng Gao</i>	
Incorporating Medical History to Cost Sensitive Classification with Lazy Learning Strategy	19
<i>Zhenxing Qin, Tao Wang and Shichao Zhang</i>	
A Novel Multi-objective Compass Search	24
<i>Xiang Zhong, Wenhui Fan, Jinbiao Lin and Zuozhi Zhao</i>	
On-line Signature Verification Based on FIR System Characterizing Velocity and Direction Change of Barycenter Trajectory	30
<i>P.Thumwarin, J.Pernwong, N.Wakayaphattaramanus and T.Matsuura</i>	
Improved GA Combined with GDBP Algorithm for Forecasting Releasing Behaviors of Drug Carrier	35
<i>Li Mao, Deyu Qi and Xiaoxi Li</i>	
Optimization of Grouping Batch and Sorting Order for Smelting Charges in Refined Copper Strip Producing by AIA	40
<i>Chunguang Chang, Yunlong Zhu, Kunyuan Hu and Yi Zhang</i>	
FTIR Micro-spectroscopic Imaging Analysis Based on PCA and LS-SVM	44
<i>Xiukun Yang, Tingting Sun and Xuezhi Xiang</i>	
The Prospect on Dynamic Characteristics of Aeolian Soil	49
<i>Xiangdong Zhang, Jiashun Liu and Changyu Lan</i>	
Method of Information Process Based on Test Mining and Word Segmentation	54
<i>Binxiang Liu, Hailin Li and Xiang Cheng</i>	
A Memory Gradient Method with a New Nonmonotone Line Search Rule	59
<i>Jingyong Tang and Yunhong Hu</i>	
Face Recognition Based on Cycle Kernel and Gray Kernels	63
<i>Qiangrong Jiang and Qianqian Lu</i>	
Privacy-Preserving SVM Classification on Arbitrarily Partitioned Data	67
<i>Yunhong Hu, Guoping He, Liang Fang and Jingyong Tang</i>	
Hybrid Operation Control Method for Micro-grid based on MAS	72

[Home](#)

<i>Xuesong Zhou, Yue Gu, Youjie Ma, Liqiang Cui and Sijia Liu</i>	
Hierarchical Spatial Reasoning in Image Segmentation	76
<i>Fenglei Yang and Baomin Li</i>	
Design of ART-based Hierarchical Clustering Algorithm Using Quadratic Junction Neural Networks	81
<i>Ming Gu</i>	
Kernel Uncorrelated Supervised Discriminant Projections with Its Application to Face Recognition	86
<i>Songjiang Lou, Guoyin Zhang and Haitao Yu</i>	
Discrete Growth Competitive Ant Algorithm and Its Convergence	90
<i>Gang Zhu and Liang Ma</i>	
Comparison of Immune and Genetic Algorithms for Parameter Optimization of Plate Color Recognition	94
<i>Feng Wang, Dexian Zhang and Lichun Man</i>	
Automatic Extraction of Usable Information from Unstructured Resumes to Aid Search	99
<i>Sunil Kumar Kopparapu</i>	
Algorithm of Logistics Distribution Path Optimization Based on Intelligent Petri Net	104
<i>Yixue Luo, Lizeng Mao and Li Liu</i>	
Performance Evaluation of Active RFID Real Time Location System Based On RSSI	109
<i>Zhenting Xiang and Dong Wang</i>	
Research and Implementation of the Agent-based Personalized Service on Network Education Platform	113
<i>Yanli Song</i>	
Data Compression of Multispectral Images for FY-2C Geostationary Meteorological Satellite	118
<i>Hong Fan, Demin Li, Zhiyong Shan, Yizhi Wu and Wujun Xu</i>	
An Improved Attribute Importance Degree Algorithm Based on Rough Set	122
<i>Lisha Kong, Jianying Mai, Shengkai Mei and Yongjian Fan</i>	
Pseudo-BCK Part and Anti-Grouped Part of Pseudo-BCI Algebras	127
<i>Xiaohong Zhang</i>	
Recognition of Natural Scene Images Based on Graphs	132
<i>Qiangrong Jiang and Weina Wei</i>	
An Isolated Word Recognition System Based on DSP and Improved Dynamic Time Warping Algorithm	136
<i>Shicheng Li and Haipeng Ren</i>	
Pseudo-BCI Filters and Subalgebras in Pseudo-BCI Algebras	140
<i>Xiaohong Zhang</i>	
CBR Based Emergency Case Generating System under Engineering Accidents	145
<i>Chunguang Chang, Xiang Ma, Xiaoyu Song and Bo Gao</i>	
Negative Selection Algorithm with Variable-Sized r-Contiguous Matching Rule	150
<i>Yuebing Chen, Chao Feng, Quan Zhang and Chaojing Tang</i>	

A Triangulated Spatial Model for Detection of Spatial Characteristics of GIS Data	155
<i>Jingzhong Li and Tinghua Ai</i>	
Probabilistic Logic System Is Boolean Algebra Homomorphic with Set Algebra	160
<i>Honglan Liu, Qingshi Gao and Weidong Hao</i>	
Refined Learning of Hidden Markov Models with a Modified Baum-Welch Algorithm and Informative Components	165
<i>Mei Chen, Michael G. Madden and Yan Liu</i>	
Distance Metric Learning with Penalized Linear Discriminant Analysis	170
<i>Yang Chen, Xingang Zhao and Jianda Han</i>	
EEG-Based Vigilance Analysis by Using Fisher Score and PCA Algorithm	175
<i>Lei Cao and Jie Li and Yaoru Sun and Huaping Zhu and Chungang Yan</i>	
Direction-Relation Similarity Model Based on Fuzzy Close-Degree	180
<i>Xuehua Tang and Kun Qin</i>	
Statistical Consensus Method for Cluster Ensembles	185
<i>Clement Deus and Zhifang Liao</i>	
A New Feature Selection Method Based on Distributional Information for Text Classification	190
<i>Nianyun Shi and Lingling Liu</i>	
Improved Multi-Objective PSO Algorithm for Optimization Problems	195
<i>Lu Wang, Yongquan Liang and Jie Yang</i>	
A Evolution Model of Computer Virus Based on Immune Genetic Algorithm	199
<i>Jianping Feng, Lihua Wu and Yu Zhang</i>	
Visualizing Search Results Based on Multi-label Classification	203
<i>Zhihua Wei, Duoqian Miao, Rui Zhao, Chen Xie and Zhifei Zhang</i>	
Multilingual Parallel Corpus of UN Documents for Contrastive and Translation Studies	208
<i>Jingxiang Cao, Xuting Jin, Xueyong Gao, Jiadong Sun and Jiayang Zhou</i>	
Improving Decision Support Systems with a High Stake Community Contributed Knowledge Base	213
<i>Yannick Naudet, Thibaud Latour, Geraldine Vidou and Younes Djaghloul</i>	
Normalized Expected Utility-Entropy Investment Decision Model and its Application in Stock Selection	220
<i>Jiping Yang, Lijian Zhang and Xiaoxuan Chen</i>	
A Fish Population Counting Method Using Fuzzy Artificial Neural Network	225
<i>Xitao Zheng and Yongwei Zhang</i>	
Maximizing the Reliability of Two-state Automaton for Burst Feature Detection in News Streams	229
<i>Gang Du, Jun Guo, Weiran Xu and Zhen Yang</i>	
Content Semantic Filter Based on Domain Ontology	234
<i>Chunxiao Fan, Jie Song, Zhigang Wen and Yuexin Wu</i>	
Recent Advances in Landmarks Research	238
<i>Jingjing Zhao and Dayou Liu</i>	
Frequent Neighboring Class Set Mining with Constraint Condition	242
<i>Gang Fang, Jiang Xiong and Xiaofeng Chen</i>	

A Collaborative Filtering Recommendation Algorithm Based on Improved Similarity Measure Method	246
<i>Yueping Wu and Jianguo Zheng</i>	
System Identification on Rotation Motion Pattern of Trimaran Unmanned Surface Vessel	250
<i>Jian Cui, Pengyu Wang, Songlin Yang, Jingpin Yuan, Nan Zhao and Wei Wu</i>	
Estimation of Distribution Algorithm Based on Multivariate Gaussian Copulas	254
<i>Ying Gao, Xiao Hu and Huiliang Liu</i>	
The Characterization of $W\phi$-transitive Rationality and Acyclic Rationality of Fuzzy Choice Functions	258
<i>Yonghua Hao, Xuzhu Wang, Caiping Wu and Na Xue</i>	
Aerodynamic Optimization Designing of Airfoil Based on Isight	262
<i>Wei Wang, Rong Mo, Zhiyong Chang and Huibin Sun</i>	
On Surveillance and Workflow Control System Design	267
<i>Emmanuel Sardis, Vassileios Anagnostopoulos, Athanasios Voulodimos and Theodora Varvarigou</i>	
An Improved Multi-population Genetic algorithm for Job Shop Scheduling Problem	272
<i>Ming Huang, Pengfei Liu and Xu Liang</i>	
The Rank-Constrained Bisymmetric Solution of the Matrix Equation $AX=B$ and the Optimal Approximation	276
<i>Qingfeng Xiao and Dingxiu He</i>	
Comparison Study Of Several Kinds Of Inertia Weights For PSO	280
<i>Wenhua Han, Ping Yang, Haixia Ren and Jianpeng Sun</i>	
Why Classifying Search Algorithms is Essential	285
<i>John R. Woodward and Jerry Swan</i>	
Corpus-Based English Writing Research and Pedagogy for Chinese College Students: A Case Study of Causality Devices	290
<i>Jian Tao and Dawang Huang</i>	
A New Profile Identification Method Based on Multi-scale Energy Feature	295
<i>Ping Cheng, Haitian Liu and Jiaqun Zhao</i>	
Consensus Problems in Multi-agent Continuous-time Systems with Time-Delays	299
<i>Yu Wei and Hongda Fan</i>	
Application of Tabu Search Heuristic Algorithms for the Purpose of Energy Saving in Optimal Load Distribution Strategy for Multiple Chiller Water Units	303
<i>Jun Zhang and Kanyu Zhang</i>	
An Intelligent Method for Early Design and Decision of Space Payload	308
<i>Ming Wen and Chengshan Han</i>	
Research on Complex Structure-Oriented Accurate Web Information Extraction Rules	312
<i>Tao Xie, Shengsheng Shi, Fuliang Quan, Chunfeng Yuan, and Yihua Huang</i>	
A Novel Non-Lyapunov Approach in Discrete Chaos System with Rational	317

Fraction Control by Artificial Bee Colony Algorithm	
<i>Fei Gao, Yibo Qi, Qiang Yin and Jiaqing Xiao</i>	
A Forgetting-based Approach to Merging Knowledge Bases	321
<i>Dai Xu, Xiaowang Zhang and Zuoquan Lin</i>	
A Mixed Fuzzy Recursive Least-Squares Estimation for online Identification of Takagi-Sugeno Models	326
<i>Lei Pan, Shen Jiong and Peter B. Luh</i>	
Research on Sentiment Analysis Technology and Polarity Computation of Sentiment Words	331
<i>Min Wang and Hanxiao Shi</i>	
Research on the Characteristic of the Probabilistic Outputs via Random ECOC	335
<i>Xiaodan Wang and Jindeng Zhou</i>	
Dynamic Supergames on Trees	340
<i>Hui Ou and Zhongxing Ye</i>	
Real-time Pedestrian Tracking by Visual Attention and Human Knowledge Learning	345
<i>Jinhua Zeng and Yaoru Sun</i>	
An Application of Intuitionistic Fuzzy Soft Sets in A Decision Making Problem	349
<i>Pabitra Kumar Maji</i>	
Word Alignment Based Recognizing Textural Entailment	352
<i>Xinhua Zhang, Yinglin Wang and Peng Li</i>	
A Context-Based Knowledge Supply Mechanism for Product Design Process	356
<i>Helin Wen, Yinglin Wang and Jianmei Guo</i>	
Ontology based Knowledge Management and Reuse Approach in Digital Design	360
<i>Zhonghai Yu</i>	
The Study on Intelligent Control for Ore Grinding and Grading Process	364
<i>Xinjian Zhou, Nengwen Zuo and Huicai Su</i>	

PERVASIVE AND TRUSTWORTHY COMPUTING

Design and Implementation of an Efficient RSA Crypto-Processor	368
<i>Jizhong Liu and Jinming Dong</i>	
Design of A Novel Multi-Rate QC-LDPC Decoder	373
<i>Pengjun Wang, Fanglong Yi and Xiaofang Zhou</i>	
Robust Digital Image Watermarking using Region Adaptive Embedding Technique	378
<i>Chunlin Song, Sud Sudirman and Madjid Merabti</i>	
Optimization of Out-band Sensing Time in Cognitive Radios	383
<i>Rong Cong and Zhen Yang</i>	
A Relay Preselection and Contention-Based Cooperative MAC for Wireless Networks	388
<i>Yun Liu, Kai Liu and Li Fu</i>	

Study on Cerebral Vascular Extraction and Three-Dimensional Reconstruction Based on MRI	393
<i>Fei Gu and Ling Tao</i>	
A Novel Positioning Method for WLAN Based on Propagation Modeling	397
<i>Yuhong Liu and Yaokuan Wang</i>	
Partial Response Differential Network Coding in Two-way Relay Channels	402
<i>Huameng Zhou, Xiaomei Fu and Jinhua Miao</i>	
Multiscale Entropy Analysis of the Velocity Signal in Impinging Stream Mixer	407
<i>Jianwei Zhang and Yanfang Song</i>	
An Open User Model Service Platform	412
<i>Haiyan Zhao and Yanlan Chen</i>	
On the Construction of Boolean Functions with Optimal Algebraic Immunity and Good Other Properties by Concatenation	417
<i>Shouchao Song, Jie Zhang, Jiao Du and Qiaoyan Wen</i>	
A Constant-Round Perfect Parallel Coin-Tossing Protocol	423
<i>Xiaolan Zhang, Hongxiang Sun, Hua Zhang, Qiaoyan Wen and Haixia Xu</i>	
Numerical Solution of Fredholm Integral Equations by Using Bernstein Polynomials	427
<i>Jianhua Hou, Changqing Yang and Shunxu Wang</i>	
Security Analysis of Cryptosystem Based on Quasigroups	431
<i>Yingying Hu and Yunqing Xu</i>	
Composition-oriented Autonomous Web Service Aggregation and Web Service Selection Method	436
<i>Ronghua Ye and Shanshan Wei</i>	
Using 3G Network Components to Enable NFC Mobile Transactions and Authentication	441
<i>W.D. Chen, G.P. Hancke, K.E. Mayes, Y. Lien and J-H. Chiu</i>	
Password Guessing Attack on a Key Exchange Protocol Based on ECDLP	449
<i>Chungen Xu and Yanjiong Yang</i>	
Numerical Solution of Nonlinear Fredholm Integral Equations of Second Kind by Using Hybrid of Block-pulse Functions and Taylor Series	453
<i>Changqing Yang and Yanyou Guo</i>	
Design of Voltage Doubling Rectifier Circuit in Wireless Sensor Networks	456
<i>Jianbin Zhang and Zhongning Jia</i>	
Fast Polarization Construction on Binary Discrete Memoryless Channels	460
<i>Dazu Huang, Jianquan Xie and Ying Guo</i>	
Certificate-based Proxy Signature	465
<i>Jianneng Chen and Zhenjie Huang</i>	
An Improved DV-Hop Localization Algorithm	469
<i>Jungang Zheng, Chengdong Wu, Hao Chu and Yang Xu</i>	
Ontology-based Faithfully Formalizing Activities and Reasoning for Context-Awareness	472
<i>Xiaolie Ye and Lejian Liao</i>	
Security Weaknesses of Song's Advanced Smart Card Based Password	477

Authentication Protocol	
<i>Wenbing Horng, Chengping Lee and Jianwen Peng</i>	
Redundant De Bruijn Graph Based Location and Routing for Large-Scale Peer-To-Peer System	481
<i>Jinyan Chen and Yi Zhang</i>	
GPRS-based Environment Monitoring System and Its Application in Apple Production	486
<i>Shaokun Lu, Meiyin Duan, Ping Zhao, Yunwen Lang and Xiaoyin Huang</i>	
Agent-Based Energy-efficient Routing Algorithm in Wireless Sensor Networks	491
<i>Yuqing Zhang and Danhua Hu</i>	
Source Localization Based on Particle Swarm Optimization for Wireless Sensor Network	495
<i>Yue Huang, Chengdong Wu, Yunzhou Zhang and Jian Zhang</i>	
Activity recognition from accelerometer signals based on Wavelet-AR model	499
<i>Zhenyu He</i>	
GPS Forward Model Computing Study On CPU/GPU Co-Processing Parallel System Using CUDA	503
<i>Fukang Yin, Fengshun Lu, Xiaoqun Cao and Junqiang Song</i>	
Power-aware I/O-Intensive and CPU-Intensive Applications Hybrid Deployment within Virtualization Environments	509
<i>Zhiwu Liu, Ruhui Ma, Fanfu Zhou, Yindong Yang, Zhengwei Qi and Haibing Guan</i>	
Concordance Measures of An Ordinal Sum of a Class of Copulas	514
<i>Fuxia Xu and Yongquan Dong</i>	
The P2P Grid Trust Model Based on Price Motivate Mechanism	518
<i>Shaohui Ma, Yong Wei and Xinling Sun</i>	
Research on a Self-powered Wireless Ultrasonic Flow Sensor System	522
<i>Chunyan Ma and Gengxin Li</i>	
Reconstructing Control Flow Graph for Control Flow Checking	527
<i>Jianli Li, Qingping Tan and Jianjun Xu</i>	
A Unified Approach to Enhance the Performance of ZRP for MANETs on an Urban Terrain	532
<i>SreeRangaRaju and Jitendranath Mungara</i>	
The Analysis of Classified Protection Compliance Detection Based on Dempster-Shafer Theory	537
<i>Jia Liu, Guoai Xu, Yixian Yang and Yang Gao</i>	
Detection of Coordinated Attacks Using Alert Correlation Model	542
<i>Faeiz Alserhani, Monis Akhlaq, Irfan U Awan and Andrea J Cullen</i>	
A General Search Method Based on Social Communities in P2P Networks	547
<i>Mo Hai and Shuhang Guo</i>	
An Efficient Multiple-Keyword Search Mechanism in Structured P2P Networks	552
<i>Mo Hai and Shuhang Guo</i>	
A Key Management Scheme in Wireless Sensor Networks Based on Behavior Trust	556

<i>Tao Liu and MingZheng Zhou</i>	
Green Task Scheduling Algorithms with Energy Reduction on Heterogeneous Computers	560
<i>Luna Mingyi Zhang, Keqin Li and YanQing Zhang</i>	
A Fast Seismic Data Processing Approach Based on Parallel Wavelet Transform	564
<i>Xiaolai Zhang, Yongquan Lu, Jinsong Li and Jintao Wang</i>	
On the Avionics Full Duplex Switched Ethernet Technologies	568
<i>Xin Chen, Xudong Xiang, Xuesong Zhang and Jianxiong Wan</i>	
A Privacy-Preserving Alert Correlation Model	573
<i>Jin Ma, Xiuzhen Chen and Jianhua Li</i>	
One-block Preimage Attack on 27-step DHA-256	579
<i>Jinmin Zhong and Xuejia Lai</i>	
Template-based Business Logic Customization for SaaS Applications	584
<i>Wei Chen, Beijun Shen and Zhengwei Qi</i>	
A New ID-based (t,n) Threshold Signcryption Scheme	589
<i>Xiaoyu Zhang and Ruiling Zhang</i>	

DATABASES AND INFORMATION SYSTEMS

RPC-based Adjustment Model for COSMO-SkyMed Stereo Slant/Ground-Range Images	593
<i>Zhen Li, Guo Zhang, Hongbo Pan and Qiang Qiang</i>	
On-line Soft Sensor Based on RPCA and LSSVR for Mill Load Parameters	598
<i>Jian Tang, Lijie Zhao, Heng Yue, Tianyou Chai and Wen Yu</i>	
Anomaly Detection on Time Series	603
<i>Mingyan Teng</i>	
Research and Implementation of Mass Remote Sensing Image Data Storage and Management	609
<i>Yu Liu, Kexiong Chen, Feng Gu, Jicheng Quan and Guang Yu</i>	
Probabilistic XML Data Exchange: An Algorithm for Materializing Probabilistic Solutions	613
<i>Haitao Ma, Changyong Yu, Miao Fang</i>	
Application of UCON in SSL VPN System	618
<i>Zhihe Fang, Hongjun He, Li Luo, Zhipeng Duan, Yang Wang and Wenzheng Zhang</i>	
An Efficient Algorithm for Twig Joins in Probabilistic XML	622
<i>Bo Ning, Guanyu Li, Xin Zhou and Yan Zhao</i>	
RFID Event Publishing in the EPC Networks	627
<i>Zhijun Wang, Xiujin Shi, Xiaohu Huang, Ming Du and Jiajin Le</i>	
Research on a kind of improved network transport model and its application in logistics industry	631
<i>Renwang Li, Xinli Wu, Donglong Li, Hao Luo and Sirong Zhang</i>	
The Reaserch of Lable-Mapping-Based Entity Attribute Extraction	635
<i>Huilin Liu, Chen Chen, Liwei Zhang and Guoren Wang</i>	

An Approach to Analyse Similarity of Business Process Variants	640
<i>Noor Mazlina binti Mahmud and Syafeeza binti Ahmad Radzi</i>	
Term Rewriting for Describing Constrained Policy Graph and Conflict Detection	645
<i>Nima Khairdoost and Nayereh Ghahraman</i>	
Conceptual Ascendant Feature Extraction of a Financial Corpus	652
<i>Ali Mohamed Al-Jaoua, Jihad Mohamad AlJa' am, Helmi Hammami, Fethi Ferjani, Firas Laban, Nasredine Semmar, Hassane Essafti and Samir Elloumi</i>	
An Investigation into the Effect of Information Technology on E-Health in Iran	656
<i>Mohammad Takhravanchi and Mohammad Azadnia</i>	
Improved Security Mechanism of Management Information System	661
<i>Shewei Wang and Min Song</i>	
A Preliminary Experimental Study on Optimal Feature Selection for Product Derivation Using Knapsack Approximation	665
<i>Runyu Shi, Jianmei Guo, and Yinglin Wang</i>	
Personalized Recommendation Based on Collaborative Filtering in Social Network	670
<i>Changchun Yang, Jing Sun and Ziyi Zhao</i>	
ECA Rule-Based Configurable Frame of Distributed System Monitoring	674
<i>Jingxin Peng and Jian Cao</i>	

HUMAN-COMPUTER INTERACTION & MULTIMEDIA

Local Vs Global Energy Minimization Methods: Application to Stereo Matching	678
<i>Cyril Cassisa</i>	
Generating Process Model from Feature-Based Design Model for Surface Micromachining Device	684
<i>Zheng Liu and Hua Chen</i>	
Grid Generation Based on Stress Balance	689
<i>Xinru Liu, Xuli Han and Duanfeng Liu</i>	
Automatic Generation of Geometric Base Sequences	693
<i>Rui Ling, Yuanjun He and Kairen Deng</i>	
Farsi License Plate Detection Based on Element Analysis in Complex Images	697
<i>Mehran Rasooli, Sedigheh Ghofrani and Abulfazl Ahmadi</i>	
Mesh-Guided Texture Replacement Using Intrinsic Images	701
<i>Xing Yan and Jianbing Shen</i>	
Optimal Viewpoint Selection for Volume Rendering Based on Shuffled Frog Leaping Algorithm	706
<i>Yousai Zhang and Bin Wang</i>	
A Preliminary Framework for Geometric Basis Computing Pattern	710
<i>Wei Lin, Yuanjun He and Haiyan Yu</i>	

Innovative CG Content Production through Advanced APE	714
<i>M. Doke, N. Hamaguchi, H. Kaneko and S. Inoue</i>	
Iris Localization Algorithm Based on Gray Distribution Features	719
<i>Fei Tan, Zhengming Li and Xiaoqin Zhu</i>	
Face Detection in Complex Background Based on Skin Color Features and Improved AdaBoost Algorithms	723
<i>Zhengming Li, Lijie Xue and Fei Tan</i>	
Calibration of Radial Distortion via QR Factorization	728
<i>Wenqiao Zhu, Changyu Diao and Jingzhou Huang</i>	
A Novel Red-eye Removal Approach in Digital Color Photos	733
<i>Yanfang Wang and Bo Han</i>	
Perceptual Image Hash for Tampering Detection Using Zernike Moments	738
<i>Yan Zhao and Weimin Wei</i>	
Realistic Real-Time Rendering for Ocean Waves on GPU	743
<i>Wenhui Zhang, Huan Zhou, Lin Tang and Xiaochuan Zhou</i>	
Design of a Cooperating Library for Sharing and Utilizing Interaction Design Patterns	748
<i>Jiangchuan Wu, Yimei Rao and Qinglin Sun</i>	
Optimization of H.264 Encoder Based on SSE2	752
<i>Yangxia Xiang, Huimin Zhang, Xiaoxuan Xiang, Dazhi Chen and Ling Xiong</i>	
Rebar Automatically Counting on The Product Line	756
<i>Zhiqi Su, Kangling Fang, Zhengtao Peng and Zhifan Feng</i>	
Evaluating E-Government Websites in Jordan: Accessibility, Usability, Transparency and Responsiveness	761
<i>Anas Ratib Al-Soud and Keiichi Nakata</i>	
A Skeleton Extraction Framework Based on Inner-product and Border Gap	766
<i>Zhuping Zang, Peifeng Zeng and Liping Tang</i>	
Generalized Tensor Product Bézier Surfaces	772
<i>Xuli Han, Yeqing Ren and Xinru Liu</i>	
An Effective Feature Extraction Method for Facial Expression Recognition using Adaptive Gabor Wavelet	776
<i>Behzad Oshidari and Babak N. Araabi</i>	
A Self-adaptive Alternation of Video Tracking Modes Governed by Detection of Online Kalman Performance Optimality	781
<i>Ken Chen, Dong Li, Tiefeng Xu and Chul Gyu Jhun</i>	
Saddle Point Detection for Connecting Objects in 2D Images Based on Mathematic Programming Restraints	786
<i>Ken Chen, Yicong Wang, Gangyi Jiang and Larry E. Banta</i>	
A Color Interpolation Algorithm for Bayer Pattern Digital Cameras Based on Green Components and Color Difference Space	791
<i>Lei Hua, Lei Xie and Huifang Chen</i>	
Production and Characteristics of Sensor Corrected and Geocoded Ellipsoid Corrected Products	796
<i>Bin Liu, Guo Zhang, Hongbo Pan and Wanshou Jiang</i>	

Research of Depth Information Acquisition with Two Stage Structured Light Method	800
<i>ShaoZhe Wang and Song Yang</i>	
PSF Estimation in SAR Imagery Restoration Based on Corner Reflectors	804
<i>Lijing Bu, Guo Zhang, Yinshen Lin and Tan Chen</i>	
Three-dimensional Virtual Scenery Construction of Tunnel and Its Application in Safety Monitoring	809
<i>Dongwei Qiu and Shanshan Wan</i>	
Towards Public Events Image Content Understanding	813
<i>Liang Zheng, Xin Zhang, Hui Wang and Chao Gao</i>	
Shearlet-based Image Denoising Using Bivariate Model	818
<i>Hanwen Cao, Wei Tian and Chengzhi Deng</i>	
Implementation of the virtual Campus simulation system Based on Vega API/Visual C++	822
<i>Bing Liu, Rufe Liu, Xiushan Lu, Naixia Mu, Fucheng Liu and Zhenghai Shi</i>	
Invariant Lighting Hand Posture Classification	827
<i>Thi-Thanh-Hai Tran and Thi-Thanh-Mai Nguyen</i>	
Research of Online MTM Application Scheme Based on 3D Personalized Digital Mannequin	832
<i>Xiaping Shi, Zhengwen Xie and Jiaxun Chen</i>	
Three-dimensional GIS Visility Analysis Based on Urban DEM	837
<i>Yang Yang and Xunjun Liu</i>	
What Makes Helpful Online Interactions: A study of Health Information Evaluation	842
<i>Jiao Wu</i>	
Insulator Leakage Current Data Compression Based on EMD and Compressed Sensing	847
<i>Chunjiang Pang and Xiao Xie</i>	
Logical Formalization and Reasoning for Computerized Interactive Storytelling	851
<i>Klaus P. Jantke</i>	
Toward a Taxonomy of Game Based Learning	858
<i>Klaus P. Jantke</i>	
Fingerprint Image Segmentation Based on Rectangular Block	863
<i>Yuan Ping and Huina Li</i>	
Key-frame Extraction Based on Clustering	867
<i>Rong Pan, Yumin Tian and Zhong Wang</i>	
Electronic Compass for Virtual Auditory Space	872
<i>Di Ai and Hailong Wu</i>	
Enhanced Strong Kalman Filter Applied in Precise Video Tracking for Fast Mobile Target	875
<i>Ken Chen, Xuemei Zhao, Tiefeng Xu and M. R. Napolitano</i>	
Retrieval of 3D Models Based on Multi-instance	879
<i>Lili Wan, Junqing Zhang and Zhenjiang Miao</i>	

Video Tracking of Human-faces with Occlusion Using Enhanced Camshift Approach	883
<i>Ken Chen, Xuemei Zhao, Gangyi Jiang and Hyonam Joo</i>	
Image Classification Based on Multi-feature Combination and PCA-RBaggSVM	888
<i>Yan Fu and Yanming Xian</i>	
Feature Preserving Consolidation for Unorganized Point Clouds	892
<i>Bao Li, Wei Jiang, Zhiquan Cheng, Gang Dang and Shiyao Jin</i>	
Vehicle Detection Segmentation Based on Adaboost and Grabcut	896
<i>Yan Gao, Mingang Chen and Lizhuang Ma</i>	
Nonlocal Image Denoising Algorithm based on Image Statistic	901
<i>Lei Wang and Xueqing Li</i>	
Using Adaboost and SIFT for Capturing Chinese Text Content of Natural Scene Image in Mobile Communication Network	906
<i>ShaoQing Li, Chuang Zhang and ZhiQing Lin</i>	
Fast Mesh Similarity Measuring Based on CUDA	911
<i>Jie Tang, Gangshan Wu, Bo Xu and Zhongliang Gong</i>	
Defocus Deblurring with a Coded Aperture	916
<i>Lin Mei, Xuan Cai and Weihao Liu</i>	
A Sketch Support System Based on Behavior of Designers	920
<i>Mitsuru Iwata, Yusuke Sasaki, Shun'ichi Tano, Tomonori Hashiyama and Junko Ichino</i>	
An Event-model for Constraint-based Person-centric Flows	927
<i>Tobias Unger, Hanna Eberle, Frank Leymann, and Sebastian Wagner</i>	
Multi-channel Speech Pushing System: A New Design of Non-visual Browser	933
<i>Xiangdong Wang, Zhuhui Deng, Qihua Chen, Yueliang Qian and Shouxun Lin</i>	
Pixel-based Image Fusion Using Wavelet Transform for SPOT and ETM+ Image	936
<i>Hongbo Wu and Yanqiu Xing</i>	
A Fast 3D-AAM Method using the Estimated Depth Information	941
<i>Myung-Ho Ju and Hang-Bong Kang</i>	
Speech Recognition Method Based on Weighed Autoregressive HMM	946
<i>Yamin Yang, Chaoli Wang and Yan Sun</i>	
Accompanying Pattern Detection for Tumor Pathological Section Using Statistical Method	950
<i>Yi Zhang, Jianyan Chen and Shengping Zhang</i>	
3D Model Retrieval from Multiple Photographic Images	954
<i>Qianwei Bian, Yuanjun He, Weimin Luo and Hongming Cai</i>	
A Generic Shape Decomposition	959
<i>Aicha Baya Goumeidane, Mohammed Khamadja, Hugues Benoit Cattin and Christophe Odet</i>	
A New Framework for Automatic 3D Scene Construction from Text Description	964
<i>Jiajie Lu, Canlin Li, Chao Yin and Lizhuang Ma</i>	

Edit Propagation for Natural Image Using Matting Affinity	969
<i>Shanshan Huang, Zhifeng Xie and Lizhuang Ma</i>	
Barnes-Hut Treecode on GPU	974
<i>Hu Jiang and Qianni Deng</i>	
A New Method for Handling Data Skews in Relational Joins on Graphics Processing Units	979
<i>Chao Zheng and Qianni Deng</i>	
An Optimized Method and Implementation for Parsing MP4 Metadata	984
<i>Lina Zhao and Lili Guan</i>	

SOFTWARE ENGINEERING

An Algebraic Approach to Mechanical Tabu Search Algorithm Generation	988
<i>Yujun Zheng, Haihe Shi and Jinyun Xue</i>	
Supporting Dynamic and Static Typing by Means of Union and Intersection Types	993
<i>Francisco Ortin and Miguel Garcia</i>	
Disassortativity and Degree Distribution of Software Coupling Networks in Object-oriented Software Systems	1000
<i>Yang Gao, Guoai Xu, Yixian Yang, Jia Liu and Shize Guo</i>	
Related Studies of Incremental Memory Statistics Varying with Parallel System Scale	1005
<i>Yue Hu, Weiqin Tong, Yanbao Cui, Liangliang Cai and Ying Li</i>	
Transformation from Data Flow Diagram to UML2.0 Activity Diagram	1010
<i>Fanchao Meng, Dianhui Chu and Dechen Zhan</i>	
A New Method for Code Similarity Detection	1015
<i>Liuliu Huang, Shumin Shi and Heyan Huang</i>	
Timing Properties Analysis of Real-Time Embedded Systems with AADL Model Using Model Checking	1019
<i>Hanbo Wang, Xingshe Zhou, Yunwei Dong and Lei Tang</i>	
A Universal Platform for Wireless Sensor and Actor Network Applications	1024
<i>Shuqin Zhang, Yuejun Dong, Zhiyong Dong and Yan Cui</i>	
A Service Composition Model Based On Business Process Template	1029
<i>Jiazeng Wen, Boyi Xu, Fenglin Bu and Hongming Cai</i>	
A Framework for Semantic Web Services Annotation and Discovery based on Ontology	1034
<i>Yang Liu and Zhiqing Shao</i>	
Static Analysis for Java Exception Propagation Structure	1040
<i>Xiang Qiu, Li Zhang and Xiaoli Lian</i>	
A Comprehensive Evaluation Methodology for Domain Specific Software Benchmarking	1047
<i>Zhiming Meng, Xiaoqiang Liu, Genxing Yang, Lizhi Cai, and Zhenyu Liu</i>	
Reusable Rule Patterns of Model Transformation in QVT Operational Mappings Language	1052

<i>Yang Yan, Hui Gao, Zhiqiang Fan and Li Zhang</i>	
The Service Template Composition Method Based on Separation-of-Concerns	1057
<i>Ying Li, Yue Hue, Weiqin Tong and Xiaoli Zhi</i>	
Free Form Design for Single Layer Shell Structures	1062
<i>Lei Wang, Qilin Zhang and Bin Yang</i>	
AFlow An automated web service composition based on the AI Planning and Workflow	1067
<i>Xin Li, Xinhuai Tang, Zhaoteng Song, Xiaozhou Yuan and Delai Chen</i>	
A Resource-based Approach to Formalize Use Case Specification for Web Applications	1072
<i>Weifeng Xu, Lin Deng and Yunkai Liu</i>	
Fault Evaluator: A Tool for Experimental Investigation of Effectiveness in Software Testing	1077
<i>William Jenkins, Sergiy Vilkomir and William Ballance</i>	
Research on Network Scheduling Planning Technique Based on System Simulation	1084
<i>Lianxing Hu and Denghua Zhong</i>	
An Efficient Algorithm for Automatic Equational Unifier Generation	1088
<i>Chen Chu and Guoqiang Li</i>	
A User Satisfaction Analysis Approach for Software Evolution	1093
<i>Huiying Li, Li Zhang, Lin Zhang and Jufang Shen</i>	
Formal Semantics and Verification of AADL Modes in Timed Abstract State Machine	1098
<i>Zhibin Yang, Kai Hu, Dianfu Ma, Lei Pi and Jean Paul Bodeveix</i>	

APPLIED INFORMATICS

Full polarimetric SAR Classification Based on Yamaguchi Decomposition Model and Scattering Parameters	1104
<i>Yang Han and Yongshe Shao</i>	
Research on Logistics Carbon Footprint Analysis System	1109
<i>Zhiyong Tian, Bingwu Liu and Feng Zheng</i>	
Cluster Tree Based Hybrid Semantic Similarity Measure for Social Tagging Systems	1113
<i>Changli Zhang, Jinjin Zhang and Maode Yan</i>	
Mutual Information Based Similarity Measure for Collaborative Filtering	1117
<i>Xiaobei He and Yuan Luo</i>	
Research on Heterogeneous Wireless Sensor Networks Localization Algorithms	1122
<i>Yu Hu and Yue Li</i>	
Iterative Method for a Class of Nonnegative Linear Least Squares Problems	1126
<i>Longquan Yong, Fang'an Deng and Shemin Zhang</i>	
A New Approach for Transfer Robot Navigation Based on Natural Landmark	1130
<i>Jun Zhang and Juncheng Liu</i>	

Some Results on Semidefinite Programming with Rank Constraint	1134
<i>Enbin Song, Hailing Zhou, Yunmin Zhu and Qingjiang Shi</i>	
Web 2.0 e-Voting System using Android Platform	1138
<i>César R. K. Stradiotto, Ângela I. Zotti, Cláudia O. Bueno, Sonali P. M. Bedin, Hugo C. Hoeschl, Tânia C. D. Bueno, Thiago P. S. Oliveira and Vinicius O. Mirapalheta</i>	
A Novel Pointing Algorithm for Vehicle Satellites' Antenna	1143
<i>Zhengming Li, Xiaogang Yang and Fei Tan</i>	
Dynamic Priority Back-up Algorithm Based on IEEE802.11 DCF	1147
<i>Chao Liu, Zhengming Li and Wenjuan Li</i>	
Dynamic Task Assignment of Autonomous AGV System based on Multi Agent Architecture	1151
<i>Muhammad Hafidz Fazli bin Md Fauadi, Haowen Lin and Tomohiro Murata</i>	
A Resource State-based Business Process Control Mechanism for BPM	1157
<i>Shuai Huang, Hongming Cai and Boyi Xu</i>	
The Method of Fuzzy Classification and Searching for Knowledge Meshes in Knowledgeable Manufacturing System	1162
<i>Renzi Yang, Hongsen Yan and Lili Zhu</i>	
A DeviceNet Fieldbus Data Acquisition System Based on Flex Technology and RIA Model	1167
<i>Baohua Tan and Juntao Wang</i>	
Improved (FD) TD Formulations Based on Z Transform for Anisotropic Plasma	1170
<i>Xueyu Huang, Chuangming Tong and Laixuan Ma</i>	
Research on Seismic Evacuation Dynamic Traffic Assignment Based on Cell Transmission Model	1174
<i>Fanliang Bu and Qingmei Xie</i>	
The Scoring Sequences on Profile Hidden Markov Models with Delete States Elimination by GPUs	1179
<i>Jun Li, Yanhui Li and Shuangping Chen</i>	
Evaluation of T Wave Alternans Detectors Based on a Simulation Study	1184
<i>Xiangkui Wan, Du Xu and Fulan Xie</i>	
Analysis of User Critical Interests Based on an Improved Shortest Root Tree Algorithms	1189
<i>Shaoyong Zhang and Jingjing Yang</i>	
Study on Space Evacuation Vulnerability in City Emergency	1194
<i>Fanliang Bu and Hui Fang</i>	
RTK GPS Enhanced Reliability for Automatic Container Terminal	1199
<i>Zheng Gui and Peng Xie</i>	
A General Model to Analyze DNA Methylation Effect on Transcription Factors Binding Ability	1203
<i>Weixing Feng, Kejun Wang and Bo He</i>	
Institutional Citation Index in the Application of Scientific Research Achievements Digital Repository	1207

<i>Qiao Fu and Run Yuan</i>	
Preview Fuzzy Control Method For Intelligent Vehicle Path Tracking	1211
<i>Yuan Liao, Juhua Huang and Qun Zeng</i>	
Research on Data Fusion for SINS/GPS/Magnetometer Integrated Navigation based on Modified CDKF	1215
<i>Yanling Hao, Zhaoyou Zhang and Quanxi Xia</i>	
A Smart Card Management and Application System	1220
<i>Mohamed Mohandes</i>	
The Evolution of Computerized Language Teaching and Learning: A Terminological Analysis	1226
<i>Shuli Zhao</i>	
Measuring and Control Method of Deformation Process of Generator's Retaining Rings on Hydraulic Bulging Strengthening Technology based on Virtual Instrument	1229
<i>Xianling Zhao and Jiansheng Liu</i>	
E-Commerce Application System Security Policy	1233
<i>Guangwei Qiao, Wei Pan, Jingxin Chen and Yan Liu</i>	
Trust Evaluation Method Handling Multi-factors for C2C E-Commerce	1236
<i>Zhihao Shen and Beijun Shen</i>	
The Research and Application of Education Game Design Model in Teaching Chinese as a Foreign Language	1241
<i>Li Cai, Fangyu Liu and Zhihong Liang</i>	
Robust Evaluation of Binary Collaborative Recommendation under Profile Injection Attack	1246
<i>Qingyun Long and Qiaoduo Hu</i>	
Systemic Maturity Model and Brazilian Public Software	1251
<i>Angela M. Alves, Giancarlo Stefanuto, Paula F. D. Castro and Marcelo Pessôa</i>	
Reconfigurable Computing for Accelerating Protein Secondary Structure Prediction on FPGAs	1257
<i>Lizhong Jin and Guoqing Lei</i>	
A Study and Implementation of the Watershed Runoff Extraction Algorithm in the Loess Hilly-Gully Area	1261
<i>Binbing Li</i>	
Artificial Life, The Second Law of Thermodynamics, and Kolmogorov Complexity	1266
<i>John R. Woodward and Amin Farjudian</i>	
Function Graphic Modeling Technology and Its Application in Road & Bridge Construction	1270
<i>Ling Huang and YanLiang Shang</i>	
Dissipative-based Function of Subject Librarian System in Scientific Research	1275
<i>Weili Chen , Yu Pei and Xiumei Bai</i>	
A Multi-scale Method for Extraction of Cerebral Blood Vessels	1280
<i>Shifeng Zhao, Zhongke Wu and Mingquan Zhou</i>	
The Research of Opinion Dynamic in Social Network Based on Internet	1284

<i>Yingan Cui and Xin Song</i>	
3D Editor for Multilingual Ontologies Using Universal Words	1288
<i>César R. K. Stradiotto, Sonali P. M. Bedin, Hugo C. Hoeschl and Tânia C. D. Bueno</i>	
Higher Order Factor Analysis of SERVQUAL-empirical Findings from an E-learning System	1293
<i>Ruobin Wang, Kecheng Liu, Mengmeng Zhang and Shilai Ma</i>	
Lower Data Center Power Consumption through Use of the Climate Characteristics of Cold Regions and Inter-regional Energy Integration	1303
<i>Kunikazu Tsuda, Shunichi Tano and Junko Ichino</i>	
A Study on Adoption Behavior of Mobile Commerce Consumer Based on TAM-MIA	1310
<i>Xuejun Ding and Yong Tian</i>	

[Home](#)

Invariant Lighting Hand Posture Classification

Thi-Thanh-Hai Tran, Thi-Thanh-Mai Nguyen
MICA International Research Center
Hanoi University of Science and Technology, VietNam
{thanh-hai.tran, thanh-mai.nguyen}@mica.edu.vn

Abstract—Hand posture classification is a key problem for many human computer interaction applications. However, this is not a simple problem. In this paper, we propose to decompose the hand posture classification problem into 2 steps. In the first step, we detect skin regions using a very fast algorithm of color segmentation based on thresholding technique. This segmentation is robust to lighting condition thank to a step of color normalization using neural network. In the second step, each skin region will be classified into one of hand posture class using Cascaded Adaboost technique. The contributions of this paper are: (i) By applying a step of color normalization, the posture classification rate is significantly improved under varying lighting condition; (ii) The cascaded Adaboost technique has been studied for the problem of face detection (2 classes). In this paper, it will be studied and evaluated in more detail in a problem of classification of hand postures (multi-classes).

Keywords- Hand posture classification; Cascaded Adaboost; Color normalization; Neural network; Lighting invariance

I. INTRODUCTION

Gesture recognition consists to recognizing meaningful expressions of motion of human hand/face/body. Recent years, this topic interests many researchers aiming to provide natural means for human-machine interaction. The applications of gesture recognition are manifold, ranging from sign language through medical rehabilitation to virtual reality.

A general framework for gesture recognition consists of 3 steps [2]. The first step detects regions of interest from image. The second step classifies (hand / body) postures into categories before recognizing dynamic gesture from consecutive postures. This paper focuses on hand gesture recognition particularly hand posture classification. This problem is more difficult than body posture classification because hand has more DoFs than body.

Hand detection step is not always necessary because it can be integrated in the phase of hand posture classification. In this case, the sliding technique is often applied to scan all regions in image and classify them into categories including also non-posture. This technique takes time because all regions of image including background regions will be examined. We favour the approaches doing hand region detection before hand posture classification by one main reason is that if we can detect hand regions rapidly, the time for classification will be reduced.

To detect hands, most of approaches in the literature are based on skin detection [1]. In this objective, color is a very good feature due to its simplicity and its invariance to geometrical transformation of the object as well as scale change. However, while detecting hand, color based skin

detection method detects also other regions like face, neck. In addition, this method is not efficient when images are taken under unconstrained lighting conditions.

To classify hand postures, there exists a lot of methods which differ one from another by the type of features used to represent hand posture and the method to learn hand model for classification. The feature types representing hand posture vary from global ones (color histogram, gradient orientation histogram, entire image) [4] to more and less local ones (active contour, ridge and blob, interest point) [6], [5]. The global feature based hand modelling is simple because it does not need to extract features. However, all global features based representations are not robust to occlusion. Local features overcome this drawback but sometime the detection of local feature is very sensitive to environment changes (e.g. lighting, viewpoint).

Once features characterizing hand posture are extracted, learning machine techniques are used for hand posture classification. Among learning techniques, Cascaded Adaboost has been shown to be very efficient to detect frontal face [3]. This technique is then largely applied to detect different types of object including hand posture [5]. The advantages of this technique are it creates a strong classifier from very simple weak ones and during the learning phase, it selects only significant and discriminant features to be considered later, so reduces the computational time for feature extraction. Although these advantages, Adaboost classifier requires a big enough number of training images. In addition, the method gets failed under complex lighting condition.

Lighting condition influences very much on the performance of posture classification. In this paper, we deal with hand posture classification in an unconstrained lighting condition for a real application of humane robot interaction. To be robust to lighting change, we propose to normalize image using Neural network before skin color segmentation and hand posture classification. We will show that this normalization helps to improve significantly the performance of hand posture classification in term of precision as well as recall. The figure 1 shows different steps of our method for hand posture classification.



Fig. 1. Scheme of our hand posture classification method.

The paper is organized as follow. In section II, we explain how to normalize image taken from any lighting condition using neural network technique. In section III, we explain the method for hand posture classification based on haar-like feature and Cascaded Adaboost technique. The experimental results are analysed in section IV before conclusion in the section V.

II. SKIN COLOR DETECTION INVARIANT TO LIGHTING CONDITION

The first step of hand posture classification is to detect skin pixel from image taken from any condition. In the literature, there exists a lot of approaches that have been proposed to detect skin pixel. These methods differs from the use of color space (e.g. RGB, HSL, Lab, CYrYb) and the way to model skin color distribution (probability distribution, Gaussian mixture model) which decides the technique used for classification (e.g. thresholding, Bayes rules, Neural Network). Although many works have showed that color allows to detect skin pixel with very high precision (98%) for some databases, the precision depends strongly of lighting condition, camera characteristics and human ethnics [8], [1]. Among these elements the one that influences the most on the performance of skin detection is the lighting condition. In a real application like human robot interaction, the robot moves from a room to another, wanders the hall, the lighting can vary from tungsten light to daylight, with shadow or not that makes very difficult the algorithms of hand detection based on color without any pre-processing.

To face the problem of lighting change, two approaches have been proposed. The first approach aims to update the model of skin distribution during time [10]. Following this way, the detection result obtained from the previous instant will be used to update the pre-built model. If the result at this step is not correct, the update will get false. The second approach is to normalize each image independently. More specifically, it transforms image taken from an illumination condition to a canonical illumination at which the segmentation of skin and non-skin pixels is the best. In this category, neural network technique seems to be convenient because it does not require any knowledge about scene [9]. We propose to follow the second approach to deal with lighting problem.

A. Color normalization based on neural network

We inspired the idea based on neural network for normalizing image. The neural network comprises 3 layers. The number of layers is chosen based on the work of [9]. In this paper, we would like to investigate how the number of neurons in the hidden layer influences the performance of color normalization and the computational time.

- The input layer has 3 nodes corresponding to the 3 values of color to be normalized.
- The hidden layer comprises N nodes that links the input and output layer. The number of nodes at the hidden layer is chosen by experience.

- The output layer has 3 nodes corresponding to the 3 output values (3 color channels), which are results of normalization.
- The transfer function is sigmoid
 $f(x) = \beta * (1 - e^{-\alpha x}) / (1 + e^{-\alpha x})$ with $\alpha = 0.01, \beta = 0.05$.

The algorithm consists of 2 steps: learning and normalizing. Learning phase is an iterative process. At each iteration, the input is the triplet (R, G, B) at a certain lighting condition and the desired output will be the triplet of the same point taken at canonical illumination. The network computes the output corresponding to the input and compares this output with the desired output. The error will be used to regulate weights of the network. The training phase will be stopped when the error smaller than a threshold. In our experiment, this threshold is set to 0.0001. Once the network has been trained, it can be used to normalize any image.

B. Skin segmentation based on thresholding technique

Once image is normalized, the skin segmentation can be done fastly with threshold technique. In our work, by experience, we choose the most convenient thresholds that a skin pixel must satisfy: $(R > G) \text{ AND } (R > B) \text{ AND } (R > 95) \text{ AND } (G > 40) \text{ AND } (B > 20)$

III. HAND POSTURE CLASSIFICATION

To classify hand posture, we propose to use classical method of Viola *et al.* [3]. The method models object by a set of Haar-like features and then Adaboost classifier technique is used for classification. This method is applied successfully in case of face detection. We would like to study in more detail how this method could be applied in hand posture classification problem and show how the lighting normalization helps to enhance the performance of the method.

A. Haar-like feature extraction

To model hand posture, Haar-like features is used. Haar-like feature is composed from "black and white" rectangular feature characterized by a corner, size (width, height) and orientation (0^0 or 45^0) and a value. The value is the difference between the sum of all "white" pixel values and the sum of all "black" pixel values. These values are computed in a very fast manner using integral image technique.

B. Cascaded Adaboost Classifier

Although the technique of integral image allows a very fast computation of Haar-like feature, the number of features computed for one image is very big. This number is much bigger than the size of the image - overcomplete problem. For example with the image of size 22x22, the number of features is about 100000. If we represent an image by a very big number of features like this, the searching for correspondence will be not efficient. In addition, among extracted Haar-like features, it is not true that all features are significant and discriminant for posture classification.

The Adaboost algorithm has more advantage than other learning machine techniques is that by learning a strong

classifier, it discards lots of non-significant features for hand detection. Therefore, at classification phase, only a little number of features (7-35 in our experiment) will be detected it reduces the computational time. The figure 2 shows examples of Haar-features kept after Adaboost algorithm.

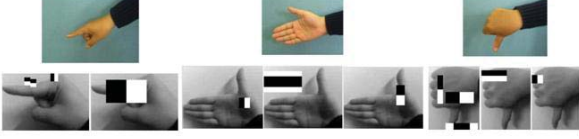


Fig. 2. Examples of Haar like features for 3 types of postures.

If we integrate Adaboost in a cascaded architecture, it will speed up still the classification because the cascade rejects all candidates which are not hand posture rapidly. A candidate will be classified into a category if it passes all layers of the cascade.

The Adaboost algorithm is resumed as follow:

- Given n example features $(x_1, y_1), (x_2, y_2), \dots, (x_n, y_n)$, where $y_i \in [0, 1]$ for negative and positive examples.
- Choose `min_detection_rate` and `max_false_alarm_rate`
- Initialize weight $w_{1,i} = 1/2m, 1/2l$ for $y_i = 0, 1$ and m, l are the number of negative and positive examples respectively.
- while the `false_alarm_rate` < `max_false_alarm_rate` and `detection_rate` > `min_detection_rate`, do:
 - 1) Initialize the number of significant features $T = 0$;
 - 2) Normalize the weights

$$w_{t,i} = \frac{w_{t,i}}{\sum_{j=1}^n w_{t,i}}$$

$w_{t,i}$ is a probability distribution
 - 3) For each feature, j , train a classifier h_j which is restricted to using a single feature. The error is evaluated with respect to $w_t, \epsilon_j = \sum_i w_i |h_j(x_j) - y_i|$
 - 4) Choose the classifier h_t with the lowest error ϵ_t
 - 5) $T = T + 1$
 - 6) Update the weights: $w_{t+1,i} = w_{t,i} \beta_t^{1-e_i}$ where $e_i = 0$ if example x_i is classified correctly, $e_i = 1$ otherwise and $\beta_t = \frac{\epsilon_t}{1-\epsilon_t}$
 - 7) Compute $F_t(x) = \sum_{i=1}^T \alpha_t h_t(x)$ for all negative and positive examples.

- The final strong classifier is

$$h(x) = \begin{cases} 1 & \text{if } F_t(x) \geq \text{threshold} \\ 0 & \text{otherwise} \end{cases}$$

Note that in this algorithm, the number of features to be selected is not chosen by hand before but T is found based on the max false alarm and min detection rate.

To reject as soon as possible all negative examples, the architecture cascade will be used. If the classifier has K stages, f_i, d_i are max false alarm rate and min detection rate respectively of the stage i , the false alarm rate and detection rate of whole cascade will be

$$F = \sum_{i=1}^K f_i, D = \sum_{i=1}^K d_i$$

In reality, each stage can have different max false alarm and min detection rate. The next stage has the smaller false alarm rate and bigger min detection rate than the previous ones. However, the number of features to be learnt will be bigger (T will be increased in the next stage.) The bigger the number of features is, the bigger the computation time is. In practice, for simplifying, we set f_i and d_i to the same value respectively. In this case, $F = f_i^K$, and $D = d_i^K$

The cascaded Adaboost classification algorithm will be explained as follow:

- Determiner f_i, d_i and the number of stages K
- Compute false alarm desired for the whole classifier F_{Target}
- $F = 1, i = 0, P, N$ are positive and negative examples respectively
- While $F > F_{Target}$
 - 1) From $P + N$ examples train the Adaboost classifier H_i with min detection rate d and max alarm rate f
 - 2) Add H_i into the cascade
 - 3) Compute false alarm for the stage i

$$F_i = \frac{k}{n}$$

with n the number of negative examples and k is the number of negative that is not correctly classified
 - 4) Take negative examples that have misclassified as input for the next iteration
 - 5) $F = F_i * F$
 - 6) $i = i + 1$

We found that the negative examples of the next stage will be the negative examples that have been misclassified at the previous stage. Therefore, the next stage will take more difficult examples for classifying.

IV. EXPERIMENTAL RESULTS

In this section, we will evaluate two things: i) how the color normalization is good, meaning how the normalized image approaches the canonical one; ii) how this normalization helps the Cascaded Adaboost algorithm to classify hand postures.

A. Evaluation of color normalization using neural network

1) *Data preparation for training:* To learn the neural network, a dataset was built. We take images containing skin from 2 subjects at different lighting conditions: canonical lighting, redlight, daylight, lowlight. When taking images, we must keep immobile camera and hand, only lighting is changed. For learning, we need to segment skin pixels from all training images. Skin pixel at the same position will be used as input and output of the network. The number of images for learning is 320 (80 images x 4 lighting conditions).

2) *Results of color normalization*: We evaluate the color normalization algorithm by comparing the average value R, G, B on skin regions of the normalized image with the ones of canonical image (image taken at canonical lighting condition). We also investigate how the number of nodes at the hidden layer influences the performance of the normalization algorithm.

To test the algorithm of color normalization based on neural network technique, we use 50 test images. These images are taken at daylight, redlight and lowlight. The figure 3 shows the results obtained from normalization algorithm. By appearance, we see that the normalized images appear quite similar to the images taken at canonical illumination. This is validated by quantitative evaluation. We compute the mean value on each channel of skin regions for each testing image. The figure 4 shows these values R, G, B for 50 images before, after normalizing, comparing with canonical image. We observe that after normalization phase, R, G, B approach near canonical lighting condition. This result is very encouraging because it assures that image is normalized correctly on skin region. Therefore, the hand detection based skin will be invariant to lighting condition.

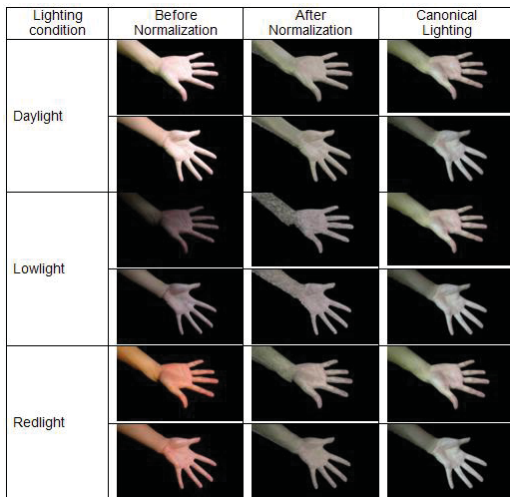


Fig. 3. Results of color normalization using neural network

One can notice also that the number of nodes at hidden layer influence slightly on the performance of the normalization (figure 4). We so choose $N = 8$ for the next experiment of hand posture classification.

B. Results of posture classification using color segmentation

4 types of postures have been considered (figure 5), each encodes a command to control the robot in an application of human-robot interaction. We learn each cascaded Adaboost classifier for one posture. The number of training images for each class (from left to right): 1) 1080 positive images, 1530 negative images; 2) 1000 positive images, 1500 negative images; 3) 1000 positive images, 1500 negative images; 4) 516 positive images and 1000 negative images. Image size is of 640x480.

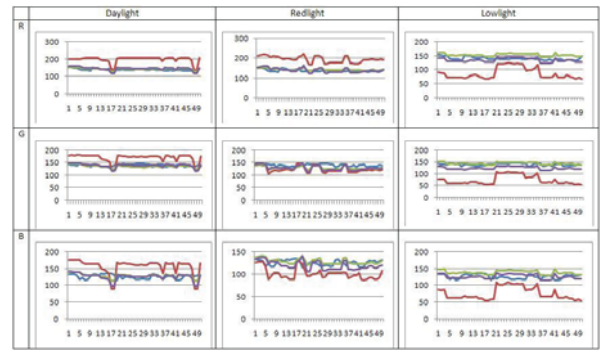


Fig. 4. Comparison of normalization performance in case of $N = 8$ and $N = 20$. Redline: before normalization. Blue line: Canonical condition. Greenline: $N = 8$. MagentaLine: $N = 20$.



Fig. 5. 4 types of posture considered in this paper.

After normalizing image, we realize a skin segmentation to keep only candidate regions for passing the cascaded Adaboost. The number of classifiers to be learnt will equal the number of postures to be classified. In this paper, we would like to investigate the help of normalization step for hand posture classification. For testing we used 550 images of hand or non-hand taken at different lighting conditions. The figure 6 compares the performance of our system with Viola and Jones’s method. We found that with the step of normalization and skin color segmentation, the performance is improved because a lot of false detections is discarded at skin segmentation. In addition, thank to normalization step, our method can handle complex lighting condition that Viola John method can not (see figure 7). However, some regions detected as non-skin regions reduces our recall (the fourth posture).

Posture	Measure	Viola Jones [3]	Our method
	Recall	81.00%	80.60%
	Precision	99.02%	100%
	Recall	89.60%	90.00%
	Precision	100%	100%
	Recall	88.37%	98.57%
	Precision	96.22%	99.38%
	Recall	93.64%	90.00%
	Precision	80.93%	100%
Average	Recall	88.15%	89.99%
	Precision	94.04%	99.84%

Fig. 6. Comparison of performance of our method and Viola et al. method [3].

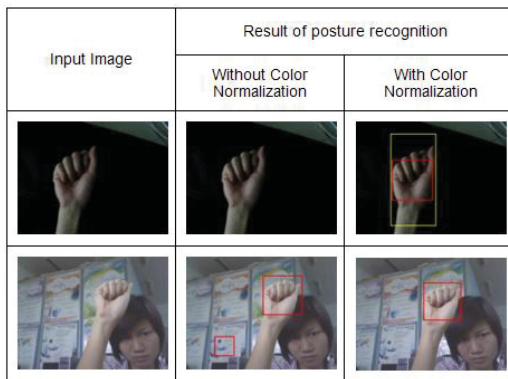


Fig. 7. Comparison of our method with Viola et al. method [3].

V. CONCLUSIONS AND FUTURE WORKS

This paper represents a method for hand posture recognition that is more robust to lighting w.r.t classical methods. Our method is composed of two phases: skin color segmentation and cascaded Adaboost based classification. We have shown that with the help of color normalization, the skin segmentation could be very fast and robust under varying lighting conditions. Once the segmentation is done, the hand posture recognition is performed only on skin regions, that discards almost false detections so improves the recall and mostly the precision of the method. For now, the normalization takes most of time because each pixel will be passed to the neural network. In the future, we would like to group neighbour pixels to pass the network in order to reduce computational time at normalization phase. In addition, we will then evaluate our method in a real application of human-robot interaction.

ACKNOWLEDGEMENT

The research leading to this paper was supported by the National Project DTDL.2009G42 "Study, design and develop smart robots to exploit multimedia information", under grant 422009GHDDTDL. We would like to thank the project and people involved in this project, mostly Dong Van Thai, for his help to prepare data.

REFERENCES

- [1] P. Kakumanu, S.M, N. Bourbakis, *A survey of skin-color modelling and detection methods*, Pattern Recognition, pp. 1106-1122, 2007.
- [2] Y. Fang, J. C. Jinqiao Wang, Kongqiao Wang, Jing Liu and Hanqing Lu *Hand Posture Recognition with Co-Training*, in 19th International Conference on Pattern Recognition. 2008. Tampa, FL.
- [3] P. Viola and M. J. Jones, *Robust Real-time Object Detection*, Cambridge Research Laboratory Technical Report Series, 01/2001.
- [4] W. T. Freeman, M. Roth, *Orientation Histograms for Hand Gesture Recognition*, in Proc. of International Workshop on Automatic Face and Gesture Recognition, pp. 296-301, 1994.
- [5] C. Wang, K. Wang, *Hand Posture Recognition Using Adaboost with SIFT for Human Robot Interaction*, International Conference on Advanced Robotics, 2007.
- [6] T. Lindeberg, *Edge detection and ridge detection with automatic scale selection*, International Journal of Computer Vision, vol 30, number 2, pp. 117-154, 1998.
- [7] S. Eghbal, G. Omar, E. Loepprich, F. Ahmadov, J. Bernshausen, *Real Time Hand Based Robot Control Using 2D/3D Images*, Lecture note in Computer Science, Volume 5359, pp. 307-316, 2008.

- [8] Michael Jones and James M. Rehg , *Statistical color Models with Application to Skin Detection*, International Journal of Computer Vision, 1999. 46(1), pp. 274-280.
- [9] A. Nayak, S.C, *Self-induced color correction for skin tracking under varying illumination* International Conference in Image Processing, pp. 1009-12 vol.2, 2003.
- [10] L. Sigal, S.S, V. Athitsos, *Skin color-based video segmentation under time-varying illumination*, IEEE Transactions on Pattern Analysis and Machine Intelligence, pp. 862 - 877, 2004.