

# NOJUN KWAK

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Seoul National University, Korea

## PERSONAL INFORMATION

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## RESEARCH INTERESTS

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**Machine learning algorithms and its applications to pattern recognition and computer vision.**

I have been mainly working on **statistical analysis** of input variables for pattern recognition problems since my graduate studies. Especially, my main research interest was to develop **feature selection and feature extraction** algorithms for pattern recognition problems such as face recognition and image registration. It requires thorough knowledge on various fields of study such as pattern recognition, machine learning, artificial neural networks, data mining and image processing.

I have been also interested in the theoretical aspect of **kernel methods** in machine learning algorithms. Also, I am interested in detecting and tracking objects in real world environments by using computer vision algorithms and their applications for autonomous vehicles and robot applications. In 2015, I participated in **DARPA robotics challenge** as a co-leader of Team-SNU.

Nowadays, **deep neural networks** are the main area of interest in my group. We deal with theoretical aspects as well as the applications of deep neural networks for various problems such as image classification, object detection, semantic segmentation, image quality enhancement, transfer learning, knowledge distillation, continual learning, semi-supervised learning, graph convolutional networks, and reinforcement learning.

## EDUCATION

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**Seoul National University**

*Mar. 1999 – Feb. 2003*

*Ph.D. in Electrical and Computer Engineering*

Supervisor: Prof. Chong-Ho Choi

Thesis: Feature selection and extraction based on mutual information for classification

**Seoul National University**

*Mar. 1997 – Feb. 1999*

*M.S. in Electrical Engineering*

Supervisor: Prof. Chong-Ho Choi

Thesis: Input feature selection for neural networks using mutual information and Taguchi method

**Seoul National University***B.S. in Electrical Engineering*

Academic Advisor: Prof. Choong-Ung Lee

*Mar. 1993 – Feb. 1997***University of Illinois at Urbana-Champaign***Visiting Graduate Student in Electrical and Computer Engineering*

Supervisor: Prof. Narandra Ahuja

*Jul. 2001 – Jun. 2002***WORK EXPERIENCES**

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**Seoul National University***Professor*Program in Intelligent Systems,  
Graduate School of Convergence Science and Technology*Mar. 2018 – Present**Seoul, Korea***Seoul National University***Associate Professor*Program in Intelligent Systems,  
Graduate School of Convergence Science and Technology*Sep. 2013 – Feb. 2018**Seoul, Korea***Ajou University***Assistant/Associate Professor*

Department of Electrical Engineering

*Mar. 2007 – Aug. 2013**Suwon, Korea***Seoul National University***BK Assistant Professor*

BK (Brain Korea) Information Technology Research Group

*Sep. 2006 – Feb. 2007**Seoul, Korea***Samsung Electronics***Senior Engineer*

Home-network Lab.

Standardization Lab.

Worked as a Samsung Delegate for 3GPP RAN3

*Mar. 2003 – Aug. 2006**Suwon, Korea***AWARDS & HONORS**

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- SL SeoBong Research Award 2008, 30 million Won (US \$ 30,000)
- DARPA Robotics Challenge Finals 2015 (12th place among 25 teams, co-leded Team-SNU)
- Korean Autonomous Vehicle Contest 2013 (4th place among 10 final teams, co-leded Team-ADAM)
- Cultural Event Classification Challenge (CVPR 2015 Workshop, 3rd place)
- ISBI 2015 Challenge on Automatic Polyp Detection in Colonoscopy Videos (3rd place)
- Imagenet Challenge (localization) (ICCV 2015 Workshop, Poster Presentation)
- Kaggle Data Science Bowl 2017 Challenge (35th place among 1,972 teams)
- Charades Action Recognition Challenge (CVPR 2017 Workshop, 5th place)

- Textbook Question Answering Challenge (CVPR 2017 Workshop, 4th both in Text Question, Diagram Question)
- Received a certificate of commendation, Ministry of Science and ICT (MSIT), Korean Government, Nov. 23, 2017.
- Honorable Mention Award in the POSETRACK CHALLENGE at ECCV2018 workshop.

## SELECTED PUBLICATIONS

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### Deep Learning

1. Seonhoon Kim, Inho Kang and Nojun Kwak, "Semantic Sentence Matching with Densely-connected Recurrent and Co-attentive Information", Thirty-Third AAAI Conference on Artificial Intelligence (AAAI-19), Jan. 2019. (arXiv)
2. Simyung Chang, John Yang, Jaeseok Choi and Nojun Kwak, "Genetic-Gated Networks for Deep Reinforcement Learning", Thirty-second Conference on Neural Information Processing Systems (NIPS2018), Montreal, Canada, Dec. 2018.
3. Jangho Kim, SeungUK Park and Nojun Kwak, "Paraphrasing Complex Network: Network Compression via Factor Transfer", Thirty-second Conference on Neural Information Processing Systems (NIPS2018), Montreal, Canada, Dec. 2018.
4. Simyung Chang, John Yang, Seonguk Park and Nojun Kwak, "Broadcasting Convolutional Network for Visual Relational Reasoning", European Conference on Computer Vision (ECCV2018), Munich, Germany, Sep. 2018.
5. Myunggi Lee, Seung Eui Lee, Sung Joon Son, Gyutae Park and Nojun Kwak, "Motion Feature Network: Fixed Motion Filter for Action Recognition", European Conference on Computer Vision (ECCV2018), Munich, Germany, Sep. 2018.
6. Jaeyoung Yoo, Sangho Lee and Nojun Kwak, "Image Restoration by Estimating Frequency Distribution of Local Patches", The Thirtieth IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR2018), Salt Lake City, UT, June 2018.
7. Daesik Kim, Youngjoon Yoo, Jeessoo Kim, Sangkuk Lee and Nojun Kwak, "Dynamic Graph Generation Network: Generating Relational Knowledge from Diagrams", The Thirtieth IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR2018), Salt Lake City, UT, June 2018.

### (Classical) Feature Extraction & Selection

1. Nojun Kwak Principal component analysis by Lp-norm maximization, IEEE Transactions on Cybernetics, vol.44, no. 5, pp. 594 - 609, May 2014.
2. Nojun Kwak, Principal component analysis based on L1 norm maximization, IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 30, no. 9, pp. 1672 - 1680, Sep. 2008.
3. Nojun Kwak and Chong-Ho Choi, Input feature selection by mutual information based on Parzen window, IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 24, no. 12, pp. 1667-1671, Dec. 2002.
4. Nojun Kwak and Chong-Ho Choi, Input feature selection for classification problems, IEEE Transactions on Neural Networks, vol. 13, no. 1, pp. 143 - 159, Jan. 2002.

### Kernel Methods

1. Nojun Kwak, "Implementing kernel methods incrementally by incremental nonlinear projection trick", IEEE Transactions on Cybernetics, vol. 47, no. 11, pp.4003 - 4009, Nov. 2017.

2. Nojun Kwak, "Nonlinear Projection Trick in Kernel Methods: An Alternative to the Kernel Trick", IEEE Transactions on Neural Networks and Learning Systems, vol. 24, no. 12, pp. 2113 - 2119, Dec. 2013.
3. Nojun Kwak, "Kernel discriminant analysis for regression problems", Pattern Recognition, vol. 45, no. 5, pp. 2019 - 2031, May 2012.

### **Low-rank Optimization**

1. Jieun Lee, Hyeogjin Lee, Minsik Lee and Nojun Kwak, "Nonparametric Estimation of Probabilistic Membership for Subspace Clustering", IEEE Transactions on Cybernetics, accepted.
2. Sungheon Park, Minsik Lee and Nojun Kwak, "Procrustean Regression: A Flexible Alignment-Based Framework for Nonrigid Structure Estimation", IEEE Transactions on Image Processing, vol. 27, no. 1, pp. 249 - 264, Jan. 2018.
3. Eunwoo Kim, Minsik Lee, Chong-Ho Choi, Nojun Kwak, and Songhwai Oh, "Efficient L1-Norm-Based Low-Rank Matrix Approximations for Large-Scale Problems Using Alternating Rectified Gradient Method", IEEE Transactions on Neural Networks and Learning Systems, vol. 26, no. 2, pp. 237 - 251, Feb. 2015.
4. Minsik Lee, Jieun Lee, Hyeogjin Lee, and Nojun Kwak, "Membership representation for detecting block-diagonal structure in low-rank or sparse subspace clustering", IEEE Conf. Computer Vision and Pattern Recognition (CVPR'15), Boston, MA, June 2015.

### **BOOK**

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1. H.-C. Shin, H.-B. Kang, N. Kwak, H.-I. Kim, S.-B. Cho, Imaging and vision systems for intelligent vehicle safety (Korean edition), HongReung Science Publisher, ISBN 9788997570492, 2012.
2. Jiyong Oh and Nojun Kwak, "Robust PCAs and PCA using generalized mean", in Advances in Principal Component Analysis – Research and Development, Springer Singapore (editor: Ganesh R. Naik), eBook ISBN 978-981-10-6704-4, 2018

### **OPEN ARCHIVE (ARXIV - UNDER REVIEW)**

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1. Jaeyoung Yoo, Hojun Lee, Nojun Kwak, "Density Estimation and Incremental Learning of Latent Vector for Generative Autoencoders", arXiv, Feb. 2019.
2. Simyung Chang, Sang-ho Lee, Nojun Kwak, "URNet : User-Resizable Residual Networks with Conditional Gating Module", arXiv, Jan. 2019.
3. Hyojin Park, Youngjoon Yoo, Geonseok Seo, Dongyoon Han, Sangdoon Yun, Nojun Kwak, "Concentrated-Comprehensive Convolutions for lightweight semantic segmentation", arXiv, Dec. 2018.
4. Simyung Chang, SeongUk Park, John Yang and Nojun Kwak, "Image Translation to Mixed-Domain using Sym-Parameterized Generative Network, arXiv, Nov. 2018.
5. Daesik Kim, Seonhoon Kim and Nojun Kwak, "Textbook Question Answering with Knowledge Graph Understanding and Unsupervised Open-set Text Comprehension", arXiv, Nov. 2018.
6. John Yang, Gyujeong Lee, Minsung Hyun, Simyung Chang, Nojun Kwak, "Towards Governing Agent's Efficacy: Action-Conditional -VAE for Deep Transparent Reinforcement Learning", arXiv, Nov. 2018.
7. Jangho Kim, Jeesoo Kim and Nojun Kwak, "HC-Net: Memory-based Incremental Dual-Network System for Continual learning", arXiv, Sep. 2018.
8. Jeesoo Kim, Jangho Kim, Jaeyoung Yoo, Daesik Kim and Nojun Kwak, "Vehicle Image Generation Going Well With the Surroundings", arXiv, July 2018.

9. YoungJoon Yoo, Seonguk Park, Junyoung Choi, Sangdoon Yun and Nojun Kwak, "Butterfly Effect: Bidirectional Control of Classification Performance by Small Additive Perturbation", arXiv, Nov. 2017.
10. Sangkuk Lee, Daesik Kim, Myunggi Lee, Jihye Hwang and Nojun Kwak, "Where to Play: Retrieval of video segments using natural-language queries", arXiv, July 2017.

## INTERNATIONAL CONFERENCES

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1. Simyung Chang, YoungJoon Yoo, Jaeseok Choi and Nojun Kwak, "BOOK: Storing Algorithm-Invariant Episodes for Deep Reinforcement Learning", 8th International Conference on Pattern Recognition Applications and Methods (ICPRAM2019), Prague, Czech Republic, February 2019.
2. Jaeseok Choi, Kyoungmin Lee, Jisoo Jeong and Nojun Kwak, "Two-Layer Residual Feature Fusion for Object Detection", 8th International Conference on Pattern Recognition Applications and Methods (ICPRAM2019), Prague, Czech Republic, February 2019.
3. Seonhoon Kim, Inho Kang and Nojun Kwak, "Semantic Sentence Matching with Densely-connected Recurrent and Co-attentive Information", Thirty-Third AAAI Conference on Artificial Intelligence (AAAI-19), Honolulu, Hawaii, Jan. 2019.
4. Simyung Chang, John Yang, Jaeseok Choi and Nojun Kwak, "Genetic-Gated Networks for Deep Reinforcement Learning", Thirty-second Conference on Neural Information Processing Systems (NIPS2018), Montreal, Canada, Dec. 2018.
5. Jangho Kim, SeungUK Park and Nojun Kwak, "Paraphrasing Complex Network: Network Compression via Factor Transfer", Thirty-second Conference on Neural Information Processing Systems (NIPS2018), Montreal, Canada, Dec. 2018.
6. Jihoon Kwon, Seungeui Lee and Nojun Kwak, " Radar Application of Deep Neural Networks for Recognizing Micro-Doppler Radar Signals by Human Walking and Background Noise", 2018 International Symposium on Antenna and Propagation, Busan, Korea, Oct. 2018.
7. Simyung Chang, John Yang, Seonguk Park and Nojun Kwak, "Broadcasting Convolutional Network for Visual Relational Reasoning", European Conference on Computer Vision (ECCV2018), Munich, Germany, Sep. 2018.
8. Myunggi Lee, Seung Eui Lee, Sung Joon Son, Gyutae Park and Nojun Kwak, "Motion Feature Network: Fixed Motion Filter for Action Recognition", European Conference on Computer Vision (ECCV2018), Munich, Germany, Sep. 2018.
9. Sungheon Park and Nojun Kwak, "3D Human Pose Estimation with Relational Networks", The British Machine Vision Conference (BMVC2018), Newcastle, UK, Sep. 2018.
10. Hyojin Park, Youngjoon Yoo and Nojun Kwak, "MC-GAN: Multi-conditional Generative Adversarial Network for Image Synthesis", The British Machine Vision Conference (BMVC2018), Newcastle, UK, Sep. 2018.
11. Sungheon Park, Taehoon Kim, Kyogu Lee and Nojun Kwak, "Music Source Separation Using Stacked Hourglass Networks", 19th International Society for Music Information Retrieval Conference (ISMIR2018), Paris, France, Sep. 2018.
12. Gyuejeong Lee, Seungeui Lee, Kwansung Kim and Nojun Kwak, " Probabilistic Track Initiation Algorithm Using Radar Velocity Information in Heavy Clutter Environments", European Microwave Week 2018 (EuMW2018), Madrid, Spain, Sep. 2018.
13. Jihoon Kwon, Seungeui Lee, and Nojun Kwak, " Human Detection by Deep Neural Networks for Recognizing Micro-Doppler Signals of Radar", European Microwave Week 2018 (EuMW2018), Madrid, Spain, Sep. 2018.

14. Jaeyoung Yoo, Sangho Lee and Nojun Kwak, "Image Restoration by Estimating Frequency Distribution of Local Patches", The Thirtieth IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR2018), Salt Lake City, UT, June 2018.
15. Daesik Kim, Youngjoon Yoo, Jeeseo Kim, Sangkuk Lee and Nojun Kwak, "Dynamic Graph Generation Network: Generating Relational Knowledge from Diagrams", The Thirtieth IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR2018), Salt Lake City, UT, June 2018.
16. Jihoon Kwon, Nojun Kwak, Eunjeoung Yang and Kwonsung Kim, "Ensemble Kalman Filter for Track-Before-Detect Algorithm of Pulsed-Doppler Radar", 22nd International Microwave and Radar Conference (MIKON2018), Pozna, Poland, May 2018.
17. Jihoon Kwon, Nojun Kwak, Dongwon Yang and Yeosun Yoon, "Development of Ground Penetrating Radar based on 48 Channel Impulse Radar Array", European Microwave Week 2017, Nuremberg, Germany, October 2017.
18. Jisoo Jeong, Hyojin Park and Nojun Kwak, "Enhancement of SSD by concatenating feature maps for object detection", The British Machine Vision Conference (BMVC2017), London, UK, Sep. 2017.
19. Hyojin Park, Jisoo Jeong, Youngjoon Yoo and Nojun Kwak, "Superpixel-based semantic segmentation trained by statistical process control", The British Machine Vision Conference (BMVC2017), London, UK, Sep. 2017.
20. Jihye Hwang, Sunghoon Park and Nojun Kwak, "Athlete pose estimation by a global-local network", CVPR 2017 Workshop (CVsports), Honolulu, Hawaii, July 2017.
21. Daesik Kim, Myunggi Lee and Nojun Kwak, "Matching Video Net: Memory-based embedding for video action recognition", International Joint Conference on Neural Networks 2017 (IJCNN2017), Anchorage, AK, May 2017.
22. Jihoon Kwon and Nojun Kwak, "Human detection by neural networks using a low-cost short-range Doppler radar sensor", 2017 IEEE Radar Conference, Seattle, WA, May 2017.
23. Sangkuk Lee, Sung Joon Son, Jiyong Oh and Nojun Kwak, "Handwritten Music Symbol Classification Using Deep Convolutional Neural Networks", Proc. The 3rd International Conference on Information Science and Security (ICISS2016), Pattaya, Thailand, Dec. 2016.
24. Sunghoon Park and Nojun Kwak, "Analysis on the Dropout Effect in Convolutional Neural Networks", Proc. Asian Conf. on Computer Vision (ACCV2016), Taipei, Taiwan, Nov. 2016.
25. Sunghoon Park, Jihye Hwang and Nojun Kwak, "3D Human Pose Estimation Using Convolutional Neural Networks with 2D Pose Information", ECCV2016 Workshop (Geometry Meets Deep Learning), Amsterdam, Netherland, Oct. 2016. (arXiv:1608.03075)
26. Myunggi Lee, Hyeogjin Lee, Jiyong Oh, Hak Jong Lee, Seung Hyup Kim and Nojun Kwak, "Unregistered Bosniak Classification with Multi-phase Convolutional Neural Networks", Proc. Int'l Conf. on Neural Information Processing (ICONIP2016), Kyoto, Japan, Oct, 2016.
27. Jihye Hwang, Younggwang Ji, Nojun Kwak and Eun Yi Kim, "Outdoor context awareness device that enables mobile phone users to walk safely through urban intersections", Proc. Int'l Conf. on Pattern Recognition Applications and Methods (ICPRAM'16), Rome, Italy, Feb. 2016.
28. John Yang, Hyeogjin Lee and Nojun Kwak, "Kernel Parameter Selection by Gap Maximization between Intra and Inter-Class Samples", Third International Conf. on Big Data and Smart Computing (BigComp'16), Hong Kong, China, Jan. 2016.

29. Sungheon Park, Myunggi Lee, Jihye Hwang, John Yang, Jieun Lee and Nojun Kwak, "Object Localization Using Image Classification Score" poster presentation at ICCV2015 Workshop (ImageNet and MS COCO Visual Recognition Challenges Joint Workshop), Santiago, Chile, Dec. 2015.
30. Sanghyun Kim, Mingon Kim, Jimin Lee, Soonwook Hwang, Joonbo Chae, Beomyeong Park, Hyunbum Cho, Jaehoon Sim, Jaesug Jung, Hosang Lee, Seho Shin, Minsung Kim, Nojun Kwak, Youngjin Lee, Sangkuk Lee, Myunggi Lee, Sang Yup Yi, Kyong-Sok K.C. Chang, Jaeheung Park, "Approach of Team SNU to the DARPA Robotics Challenge Finals", 2015 IEEE-RAS Int. Conf. on Humanoid Robots (Humanoid'15), Seoul, Korea, November 2015.
31. Sungheon Park and Nojun Kwak, "Illumination robust optical flow estimation by illumination-chromaticity decoupling", IEEE International Conf. on Image Processing (ICIP'15), Quebec City, Canada, September 2015.
32. Hyeogjin Lee and Nojun Kwak, "Character recognition for the machine reader zone of electronic identity cards", IEEE International Conf. on Image Processing (ICIP'15), Quebec City, Canada, September 2015.
33. Minsik Lee, Jieun Lee, Hyeogjin Lee, and Nojun Kwak, "Membership representation for detecting block-diagonal structure in low-rank or sparse subspace clustering", IEEE Conf. Computer Vision and Pattern Recognition (CVPR'15), Boston, MA, June 2015.
34. Sungheon Park and Nojun Kwak, "Cultural event recognition by subregion classification with convolutional neural network", Workshop in IEEE Conf. Computer Vision and Pattern Recognition (CVPR'15), Boston, MA, June 2015.
35. Sungheon Park, Myunggi Lee and Nojun Kwak, "Polyp detection in colonoscopy videos using deeply-learned hierarchical features", Presented at ISBI 2015 Challenge on Automatic Polyp Detection in Colonoscopy Videos, New York, NY, April 2015.
36. Kanishka Tyagi, Nojun Kwak and Michael Manry, "Optimal conjugate gradient algorithm for generalization of linear discriminant analysis based on L1 norm", Proc. Int'l Conf. on Pattern Recognition Applications and Methods (ICPRAM'14), pp. 207 – 212, Angers, France, March 2014.
37. Seaung-Lok, Ham and Nojun Kwak, "Boosted-PCA for binary classification problems", Proc. IEEE Int. Symposium on Circuits and Systems (ISCAS'12), Seoul, Korea, May 2012.
38. Ji-Eun Lee and Nojun Kwak, "Detection and recovery of occluded face images based on correlation between pixels", Proc. 1st International Conference on Pattern Recognition Applications and Methods (ICPRAM'12), vol. 2, pp. 568 – 571, Vilamoura, Algarve, Portugal, February, 2012.
39. Jae Hyun Oh and Nojun Kwak, "Robust face recognition under a polar coordinate system", Proc. the 2011 International Conference on Image Processing, Computer Vision, & Pattern Recognition (ICCV11), Las Vegas, NV, July 2011.
40. Jae Hyun Oh and Nojun Kwak, "Robust face recognition in a polar coordinate system using LDAR", Proc. the 2nd International Conf. on Internet (ICONI10), Mactan Island, the Philippines, Dec. 2010.
41. Jiyong Oh, Chong-Ho Choi and Nojun Kwak, "MAP Classifier with BDA features", Proc. the 6th International Conference on Fuzzy Systems and Knowledge Discovery (FSKD'09), pp.227 – 231, Tianjin, China, Aug. 2009.
42. Nojun Kwak, Sang-Il Choi, and Chong-Ho Choi, "Feature extraction for regression problems and an example application for pose estimation of a face", Proc. Intl Conf. on Image Analysis and

- Recognition (ICIAR08) (Also presented in Lecture Notes in Computer Science, vol. 5112), pp. 435 – 444, Povoá de Varzim, Portugal, July 2008.
43. Nojun Kwak, Feature extraction with weighted samples based on independent component analysis, Proc. Intl Conf. on Artificial Neural Networks (ICANN06) (Also presented in Lecture Notes in Computer Science, vol. 4132), pp. 340 – 349, Athens, Greece, Sep. 2006.
  44. Nojun Kwak and Chunghoon Kim, Dimensionality reduction based on ICA for regression problems, Proc. Intl Conf. on Artificial Neural Networks (ICANN06) (Also presented in Lecture Notes in Computer Science, vol. 4131), pp. 1 – 10, Athens, Greece, Sep. 2006.
  45. Nojun Kwak and Chong-Ho Choi, Feature extraction using mutual information based on Parzen window, Proc. Intl Conf on Artificial Neural Network and Neural Information Processing (ICANN/ICONIP03), pp. 278 – 281, Istanbul, Turkey, June 2003.
  46. Nojun Kwak, Chong-Ho Choi, and Narendra Ahuja, Face recognition using feature extraction based on independent component analysis, Proc. Intl Conf. on Image Processing (ICIP02), vol. 2, pp. 337 – 340, Rochester, New York, Sep. 2002.
  47. Nojun Kwak, Chong-Ho Choi, A new method of feature extraction and its stability, Proc. Intl Conf. on Artificial Neural Networks (ICANN02) (Also presented in Lecture Notes in Computer Science, vol. 2415) pp. 480 – 485, Madrid, Spain, Aug. 2002.
  48. Nojun Kwak, Chong-Ho Choi, and Jin-Young Choi, Feature Extraction using ICA, Proc. Intl Conf. on Artificial Neural Networks (ICANN01) (Also presented in Lecture Notes in Computer Science, vol. 2130), pp. 568 – 573, Vienna, Austria, Aug. 2001.
  49. Chong-Ho Choi and Nojun Kwak, Disturbance attenuation in robot control, Proc. Intl Conf. on Robotics and Automation (ICRA01), vol. 3, pp. 2560 – 2565, Seoul, Korea, May 2001.
  50. Nojun Kwak and Chong-Ho Choi, Improved mutual information feature selector for neural networks in supervised learning, Proc. Int'l Joint Conf. on Neural Networks (IJCNN99), vol. 2, pp. 1313 – 1318, Washington D.C., July 1999.

## INTERNATIONAL JOURNALS

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1. Jieun Lee, Hyeogjin Lee, Minsik Lee and Nojun Kwak, "Nonparametric Estimation of Probabilistic Membership for Subspace Clustering for publication", IEEE Transactions on Cybernetics, accepted.
2. Sungheon Park and Nojun Kwak, "Independent Component Analysis by lp-norm Optimization", Pattern Recognition, vol. 76, no. 4, pp. 752 - 760, April 2018.
3. Sungheon Park, Minsik Lee and Nojun Kwak, "Procrustean Regression: A Flexible Alignment-Based Framework for Nonrigid Structure Estimation", IEEE Transactions on Image Processing, vol. 27, no. 1, pp. 249 - 264, Jan. 2018.
4. Nojun Kwak, "Implementing kernel methods incrementally by incremental nonlinear projection trick", IEEE Transactions on Cybernetics, vol. 47, no. 11, pp.4003 - 4009, Nov. 2017.
5. Jiyong Oh, Sung Joon Son, Sangkuk Lee, Ji-Won Kwon and Nojun Kwak, "Online recognition of handwritten music symbols", International Journal of Document Analysis and Recognition, vol. 20, no. 2, pp. 79 - 89. June 2017.
6. Sanghyun Kim, Mingon Kim, Jimin Lee, Soonwook Hwang, Joonbo Chae, Beomyeong Park, Hyunbum Cho, Jaehoon Sim, Jaesug Jung, Hosang Lee, Seho Shin, Minsung Kim, Wonje Choi, Yisoo Lee, Sumin Park, Jiyong Oh, Yongjin Lee, Sangkuk Lee, Myunggi Lee, Sangyup Yi, Kyong-Sok K.C. Chang, Nojun Kwak, and Jaeheung Park "Team SNU's Control Strategies to Enhancing



- Robots Capability: Lessons from the DARPA Robotics Challenge Finals 2015”, *Journal of Field Robotics*, vol. 34, no. 2, pp. 359 - 380, March 2017.
7. Jiyong Oh and Nojun Kwak, ”Generalized mean for robust principal component analysis”, *Pattern Recognition*, vol. 54, pp. 116-127, June 2016.
  8. Eunwoo Kim, Minsik Lee, Chong-Ho Choi, Nojun Kwak, and Songhwai Oh, ” Efficient L1-Norm-Based Low-Rank Matrix Approximations for Large-Scale Problems Using Alternating Rectified Gradient Method”, *IEEE Transactions on Neural Networks and Learning Systems*, vol. 26, no. 2, pp. 237 - 251, Feb. 2015.
  9. Nojun Kwak Principal component analysis by Lp-norm maximization, *IEEE Transactions on Cybernetics*, vol.44, no. 5, pp. 594 - 609, May 2014.
  10. Nojun Kwak, ” Nonlinear Projection Trick in Kernel Methods: An Alternative to the Kernel Trick”, *IEEE Transactions on Neural Networks and Learning Systems*, vol. 24, no. 12, pp. 2113 - 2119, Dec. 2013.
  11. Jiyong Oh, Nojun Kwak, Minsik Lee and Chong-Ho Choi, Generalized mean for feature extraction in one-class classification problems, *Pattern Recognition*, vol. 46, no. 12, pp. 3328 - 3340, Dec. 2013.
  12. Jae Hyun Oh and Nojun Kwak, Generalization of linear discriminant analysis using Lp-norm, *Pattern Recognition Letters*, vol. 34, no. 6, pp. 679 - 685, April 2013.
  13. Sang-Il Choi, Chong-Ho Choi, Gu-Min Jeong and Nojun Kwak, Pixel selection based on discriminant features with application to face recognition, *Pattern Recognition Letters*, vol. 33. no. 7, pp. 1083 - 1092, July 2012.
  14. Jae Hyun Oh and Nojun Kwak, Recognition of a driver’s gaze for vehicle headlamp control, *IEEE Transactions on Vehicular Technology*, vol. 61, no. 5, pp. 2008 - 2017, June 2012.
  15. Nojun Kwak, Kernel discriminant analysis for regression problems, *Pattern Recognition*, vol. 45, no. 5, pp. 2019 - 2031, May 2012.
  16. Jungtai Kim, Hyun Jong Yang and Nojun Kwak, Low-angle tracking of two objects in three-dimensional beamspace domain, *IET Radar, Sonar Navigation*, vol. 6, no. 1, Jan. 2012.
  17. Eun-Chan Park, Nojun Kwak, Suk Kyu Lee, Jong-Kook Kim and Hwangnam Kim, Provisioning QoS for WiFi-enabled Portable Devices in Home Networks, *KSII Trans. on Internet and Information Systems*, vol. 5, no. 4, pp. 720 - 740, April, 2011.
  18. Sang-Il Choi, Chong-Ho Choi and Nojun Kwak, Face recognition based on 2D images under illumination and pose variations, *Pattern Recognition Letters*, vol. 32, pp. 561 - 571, March 2011.
  19. Nojun Kwak and Jung-Won Lee Feature extraction based on subspace methods for regression problems, *Neurocomputing*, vol. 73, no. 10, pp. 1740 - 1751, June 2010.
  20. Gu-Min Jeong, Hyun-Sik Ahn, Sang-Il Choi, Nojun Kwak, and Chanwoo Moon, ” Pattern Recognition Using Feature Feedback: Application to Face Recognition”, *International Journal of Control, Automation, and Systems*, vol. 8, no. 1, pp. 141 - 148, Jan. 2010.
  21. Nojun Kwak and Jiyong Oh, Feature extraction for one-class classification problem: Enhancements to biased discriminant analysis, *Pattern Recognition*, vol. 42, no. 1, pp. 17 - 26, Jan. 2009.
  22. Nojun Kwak, Principal component analysis based on L1 norm maximization, *IEEE Transactions on Pattern Analysis and Machine Intelligence*, vol. 30, no. 9, pp. 1672 - 1680, Sep. 2008.

23. Nojun Kwak, Chunghoon Kim and Hwangnam Kim, Dimensionality reduction based on ICA for regression problems, *Neurocomputing*, vol. 71, no. 13, pp. 2596–2603, Aug. 2008.
24. Nojun Kwak, Feature extraction for classification problems and its application to face recognition, *Pattern Recognition*, vol. 41, no. 5, pp. 1701–1717, May 2008.
25. Nojun Kwak, Feature extraction based on direct calculation of mutual information, *International Journal of Pattern Recognition and Artificial Intelligence*, vol. 21, no. 7, pp. 1213–1231, Nov. 2007.
26. Chong-Ho Choi and Nojun Kwak, Robust control of robot manipulator by model-based disturbance attenuation, *IEEE/ASME Transactions on Mechatronics*, vol. 8, no. 4, pp. 511–513, Nov./Dec. 2003.
27. Nojun Kwak and Chong-Ho Choi, Feature extraction based on ICA for binary classification problems, *IEEE Transactions on Knowledge and Data Engineering*, vol. 15, no. 6, pp. 1374–1388, Nov. 2003.
28. Nojun Kwak and Chong-Ho Choi, Input feature selection by mutual information based on Parzen window, *IEEE Transactions on Pattern Analysis and Machine Intelligence*, vol. 24, no. 12, pp. 1667–1671, Dec. 2002.
29. Nojun Kwak and Chong-Ho Choi, Input feature selection for classification problems, *IEEE Transactions on Neural Networks*, vol. 13, no. 1, pp. 143–159, Jan. 2002.

## INVITED TALKS

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1. Maximizing L1 norm in data analysis, in *The First International Symposium on System Informatics and Engineering*, Qingdao, China, 2011.
2. L1 norm optimization in subspace learning methods, in *AI-2011 Thirty-first SGAI International Conference on Artificial Intelligence*, Cambridge, UK, 2011.

## OTHER ACHIEVEMENTS

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- IEEE Senior Member
- 10+ Korean Journal papers
- 30+ Korean Domestic Conference papers
- Around 30+ registered patents