ARULMURUGAN AMBIKAPATHI M.E., Ph.D.

MIEEE, MISTE, AMIETE

Team Lead & Senior Algorithm Engineer, UTECHZONE Co., Ltd.,, Office: No. 268, 10F, #1, Liancheng Road, Zhonghe Dist., New Taipei City, Taiwan-23553. Ph: +886–978357814. Mail-id: <u>a.arulmurugan@gmail.com</u> Web: <u>http://mx.nthu.edu.tw/~aambikapathi/</u>



<u>Objective:</u> Seeking a position to utilize / hone my skills and abilities in Image Analysis Research and Development, in a firm that offers professional growth while being resourceful and supportive.

EXPERTISE & PASSION

- Image Processing and Analysis (Current: Computer Vision & Deep Learning for Object Inspection (AOI))
- Robust Blind Source Separation / Unmixing (Satellite Hyperspectral and Bio-Medical Image Analysis)
- Convex Analysis and Optimization: Algorithms for Image Analysis and related Applications

INUDUSTRIAL, RESEARCH, & ACADEMIC EXPERIENCES

- Team Leader (Deep Learning + Computer Vision for AOI) at UTECHZONE Co., Ltd., since Dec. 2016.
- Senior Algorithm Engineer at UTECHZONE Co., Ltd., since Sept. 2014.
- Postdoctoral Research Fellow at Institute of Comm. Eng., NTHU, Taiwan, Sep. 2011 ~ Aug. 2014.
- Visiting Scholar at Dept. of Electrical Engineering, Chinese University of Hong Kong, Feb. 2010.
- Teaching Assistant for the graduate course Convex Optimization, in Spring 2009, 2010, and 2011.
- **Teaching Assistant** for the graduate course Communication System II, in Fall 2008.
- Assistant Professor at SSN College of Engineering, from Aug. 2006 to Aug. 2007.
- Lecturer at Mepco Schelenk Engineering College, from Apr. 2005 to May 2006.

INDUSTRIAL / ACADEMIC ACHIEVEMENTS

- ✓ UTECHZONE Co. Ltd, GOLD MEDAL FOR EXCELLENCE Award, 2015 and 2016.
- ✓ UTECHZONE Co. Ltd, **TOP PERFORMER** quarterly Award, won since Jan. 2015 till date.
- ✓ Best Ph.D. Dissertation Award from *IEEE Geoscience and Remote Sensing Society*, Taipei Chapter.
- ✓ Mentioned in "Marquis Who is Who" in the World 2012 Edition.
- ✓ National Tsing Hua University Outstanding Student Scholarship award for the academic year 2009-10 and 2010-2011.
- ✓ Received the "BEST PAPER AWARD" at the IEEE WHISPERS 2011.
- ✓ University Rank No: 3 in ANNA UNIVERSITY's M.E. Program (2003-05).
- ✓ University Rank No: 5 in BHARATHIDASAN UNIVERSITY's B.E. Program (1999-2003).
- ✓ Won *GOLD* MEDAL for Academic Performance J.J.College Of Engg & Tech (B.E. Program).
- ✓ Won SILVER MEDAL for Academic Performance in Mepco Schlenk Eng. College (M.E. Program).
- ✓ Won the award for **BEST ACADEMIC PROFICIENCY** (<u>5 Times</u> during 1999-2003 and 2005).

RECENT / CURRENT - MAJOR INDUSTRIAL RESEARCH PROJECTS (Past 5 years)

Title: Advanced and Robust Automated Object Inspection Algorithms development for various Computer Vision and Pattern Recognition Applications (UTECHZONE Co. Ltd.,) *Duration:* Since Sep. 2014 ~ .

Clients: Major LCD, CCD, PCB, IC, Touch Screen, and Mobile phone Manufacturers.

Contributions: The Automated Object Inspection (AOI) industry is one of the hot, challenging fields wherein the task is to employ automatic and robust means to effectively and efficiently identify the defects (ranging from apparent defects to very faint defects). The task requires deep expertise in development of novel computer vision and pattern recognition algorithms (and their efficient implementation) to preprocess and analyze the AOI images. Over the past three years I have been responsible for the development of many such powerful algorithms, which are currently being used in the AOI machines world-wide. Some of the major projects include Mura defect identification on LCD Panels, Akkon identification, PCB Bend defect identification, Image rotation correction, alignment, and concatenation, automatic ROI for target inspection, sub-pixel precise contour defect identification, housing board and SD card minute line defect identification, automatic mask alignment and scaling, etc. Recently, I am leading a team that focuses on deep learning (DL) based AOI defect classification and localization. A blend of computer vision algorithms and DL ideologies are used to design a highly precise and robust defect classification system.

PAST ACADEMIC RESEARCH PROJECTS

Title: Robust and Reliable Blind Source Separation for Biomedical, Hyperspectral, and GeneExpression Data Analysis (Sponsors: NSC, Taiwan and NTHU)*Duration:* Aug. 2013 to Aug. 2014.

Collaborators: Prof. Wing-Kin Ma, Chinese Univ. of Hong Kong, and Prof. Yue Wang, Virginia Tech

Contributions: The prime objective of this 3-year interdisciplinary project was to develop and validate novel, robust, and reliable *Image Processing* (IP) algorithms with efficient implementations for solving the core problems in Biomedical, Hyperspectral, and Gene Expression Data Analysis. Under realistic signal models, and exploiting the inherent diversities, the cutting-edge advanced IP algorithms are designed based on the advanced *convex analysis and optimization theory* (which recently has drawn extensive attention in signal processing and communications). The design of IP algorithms included *model order selection, dimension/noise reduction, robust separation criterion establishment, source identifiability analysis, algorithm development, performance and convergence analysis, and complexity reduction for real-time implementations.*

Title: Advanced Blind Source Separation for Biomedical and Hyperspectral Image Analysis

(Sponsors: NSC, Taiwan and NTHU)

Duration: Aug. 2010 to Jul. 2013.

Collaborators: Prof. Wing-Kin Ma, Chinese Univ. of Hong kong, and Prof. Yue Wang, Virginia Tech

Contributions: The researches accomplished are interdisciplinary multiple-input multiple-output (MIMO) signal processing topics as follows: #1.Early-stage cancer detection using biomedical images: Devised novel and reliable image processing (IP) algorithms based on convex analysis and optimization for solving the tissue heterogeneity problem; dissected and characterized the extracted source signals (i.e., biomarkers) so as to identify the dominant phenotype of cancer at its early stage; applied dominant phenotype of the early-stage cancer to clinical diagnosis and prognosis. #2.Mineral discovery using hyperspectral images: Devised novel and reliable IP algorithms based on convex analysis and optimization for solving the mixed pixel problem; Validated the efficacy of the developed IP algorithms with real hyperspectral image data and the ground truth that can be found in the USGS library.

Title: Evaluation of Treatment Response in Patients with Liver cancer via Pharmacokinetic Analysisin DCE-MRI (Sponsors: NTHU and McKay Hospital, Taipei)Duration: Jan. 2013 to Dec. 2013.

Collaborators: Dr. Fei-Shih Yang, McKay Hospital, and Prof. Yue Wang, Virginia Tech

Contributions: The prime focus of this project was to develop effective and efficient IP (IP) algorithms for estimation of the AIF and kinetic parameters in DCE-MRI images, so as to facilitate early stage diagnosis and evaluate the liver cancer treatment response. This kinetic parameter estimation problem is mathematically formulated by considering a latent variable model, which is a linear mixing model of kinetic parameters (sources) with unknown mixing coefficients. The results obtained in this project significantly contributed to advances in image processing theory for biomedical image analysis, and also aided in clinical diagnosis and prognosis of liver cancer patients.

Title: Early-stage Prostate Cancer Detection Using Advanced DCE-MR Image Analysis

(Sponsors: NTHU and McKay Hospital, Taipei)

Duration: Jan. 2012 to Dec. 2012.

Collaborators: Dr. Fei-Shih Yang, McKay Hospital, and Prof. Yue Wang, Virginia Tech

Abstract: The focus of this project was to develop, refine, and validate reliable and efficient unsupervised IP methods to dissect and characterize composite signatures in DCE-MRI images obtained from the patients having prostate cancers, so as to facilitate effective early-stage disease detection. Based on advanced optimization and pattern analysis techniques, for the conventional three-tissue compartment model, we have proposed a reliable unsupervised algorithm namely, convex optimization based kinetic parameter estimation (COKE) algorithm to dissect and characterize the composite signatures in DCE-MR images of patients with prostate cancers.

List of IEEE Publications

IEEE Journals:

- [J1]. A. Ambikapathi *, T.-H. Chan, C.-H. Lin, F.-S. Yang, C.-Y. Chi, and Y. Wang, "Convex optimization-based compartmental pharmacokinetic analysis for prostate tumor characterization using DCE-MRI," *IEEE Transactions on Biomedical Engineering*, vol. 63, no. 4, pp. 707-720, April 2016 (* Corresponding Author) (Impact Factor: 2.35, JCR Journal Ranking 28/76).
- [J2]. C.-H. Lin, W.-K. Ma, W.-C. Li, C.-Y. Chi, and A. Ambikapathi, "Identifiability of the simplex volume minimization criterion for blind hyperspectral unmixing: The no pure-pixel case," *IEEE Transactions on Geoscience and Remote Sensing*, vol. 53, no. 10, pp. 5530-5546, Oct. 2015.(Impact Factor: 3.51, JCR Journal Ranking 15/249).
- [J3]. W.-K. Ma, J. M. Bioucas-Dias, P. Gader, T.-H. Chan, N. Gillis, A. Plaza, A. Ambikapathi, and C.-Y. Chi, "Signal processing perspective on hyperspectral unmixing," *IEEE Signal Processing Magazine*, vol. 31, no.1, pp. 67-81, January 2014. (Impact factor: 5.85, JCR Journal Ranking: 4/249).
- [J4]. A. Ambikapathi, T.-H. Chan, C.-Y. Chi, and K.Keizer, "Hyperspectral data geometry based estimation of number of endmembers using p-norm based pure pixel identification," *IEEE Trans. Geoscience and Remote Sensing*, vol. 51, no. 5, pp. 2753-2769, May 2013. (Impact factor: 3.51, JCR Journal Ranking: 15/249).
- [J5]. T.-H. Chan, A. Ambikapathi, W.-K. Ma, and C.-Y. Chi, "Robust affine set fitting and fast simplex volume max-min for hyperspectral endmember extraction," *IEEE Trans. Geoscience and Remote Sensing*, vol. 51, no. 7, pp. 3982-3997, July 2013. (Impact factor: 3.51, JCR Journal Ranking: 15/249).
- [J6]. A. Ambikapathi, T.-H. Chan, W.-K. Ma, and C.-Y. Chi, "Chance constrained robust minimum volume enclosing simplex algorithm for hyperspectral unmixing," *IEEE Trans. Geoscience and Remote Sensing*, vol. 49, no. 11, pp. 4194-4209, Nov. 2011. (Impact factor: 3.51, JCR Journal Ranking: 15/249).
- [J7]. T.-H. Chan, W.-K. Ma, A. Ambikapathi, and C.-Y. Chi, "A simplex volume maximization framework for hyperspectral endmember extraction," *IEEE Trans. Geoscience and Remote Sensing*, vol. 49, no. 11, pp. 4177-4193, Nov. 2011. (Impact factor: 3.51, JCR Journal Ranking: 15/249).

IEEE International Conference Papers:

- [C1] <u>A. Ambikapathi</u>, Y.-T Cheng, and G.-S. Hsu, "Reliable age estimation based on apt Gabor features selection and SVM," in Proc. ACCV WFI, Taipei, Taiwan, Nov. 20, 2016.
- [C2] G.-S. Hsu, Y.-R. Chen, <u>A. Ambikapathi</u>, and Y.-X. Chen, "Relating facial attractiveness with facial attributes - A deep learning perspective," in *Proc. CVGIP*, Keelung, Taiwan, Aug. 15-17, 2016.

- [C3] <u>A. Ambikapathi</u>, T.-H.Chan, C.-H. Lin, C.-Y Chi, "Convex geometry based outlier-insensitve estimation of number of endmembers in hyperspectral images," in *Proc. IEEE WHISPERS-2013*, Gainesville, Florida, Jun.-25-28, 2013. (Invited paper)
- [C4] C.-H. Lin*, <u>A. Ambikapathi*</u>, W.-C. Li, and C.-Y. Chi, "On the endmember identifiability of Craig's criterion for hyperspectral unmixing: A statistical analysis for three-source case,"in *Proc. IEEE ICASSP-2013*, Vancouver, Canada, May 26-31, 2013. (* contributed equally)
- [C5] H.-E. Huang, T.-H. Chan, <u>A. Ambikapathi</u>, W.-K. Ma, and C.-Y. Chi, "Outlier-robust dimension reduction and its impact on hyperspectral endmember extraction," in *Proc. IEEE WHISPERS-2012*, Shanghai, China, Jun. 5-7, 2012. (Invited paper)
- [C6] <u>A. Ambikapathi</u>, T.-H. Chan, K. Keizer, F.-S. Yang, and C.-Y. Chi, "An nBSS algorithm for pharmacokinetic analysis of prostate cancer using DCE-MR images," in *Proc. IEEE International Symposium on Biomedical Imaging: From Nano to Macro (ISBI)*, Barcelona, Spain, May 2-5, 2012, pp. 566-569.
- [C7] <u>A. Ambikapathi</u>, T.-H. Chan, and C.-Y. Chi, "Convex geometry based estimation of number of endmembers in hyperspectral images," in *Proc. IEEE ICASSP*, Kyoto, Japan, Mar. 25-30, 2012, pp. 1233-1236.
- [C8] T. Chan, J.-Y. Liou, <u>A. Ambikapathi</u>, W.-K. Ma and C.-Y. Chi, "Fast algorithms for robust hyperspectral endmember extraction based on worst-case simplex volume maximization," in *Proc. IEEE ICASSP*, Kyoto, Japan, Mar. 25-30, 2012, pp. 1237-1240.
- [C9] T.-H. Chan, C.-J. Song, <u>A. Ambikapathi</u>, C.-Y. Chi, and W.-K. Ma, "Fast alternating volume maximization algorithm for blind separation of non-negative sources," in *Proc. IEEE International Workshop on Machine Learning for Signal Processing (MLSP)*, Beijing, China, Sep. 18-21, 2011.
- [C10] T.-H. Chan, W.-K. Ma, <u>A. Ambikapathi</u>, and C.-Y. Chi, "Robust endmember extraction using worst-case simplex volume maximization," in *Proc. IEEE WHISPERS-2011*, Lisbon, Portugal, Jun. 6-9, 2011. (BEST PAPER AWARD)
- [C11] T.-H. Chan, W.-K. Ma, <u>A. Ambikapathi</u>, and C.-Y. Chi, "An optimization perspective on Winter's endmember extraction belief," in *Proc. IEEE International Geoscience and Remote Sensing Symposium (IGARSS'11)*, Vancouver, Canada, Jul. 24-29, 2011. (Invited paper)
- [C12] <u>A. Ambikapathi</u>, T.-H. Chan, C.-Y. Chi, and K. Keizer, "Two effective and computationally efficient purepixel based algorithms for hyperspectral endmember extraction," in *Proc. IEEE ICASSP*, Prague, Czech Republic, May 22-27, 2011, pp. 1369-1372.
- [C13] <u>A. Ambikapathi</u>, T.-H. Chan, W.-K. Ma, and C.-Y. Chi, "A robust alternating volume maximization algorithm for endmember extraction in hyperspectral images," in *Proc. IEEE WHISPERS*, Iceland, Jun. 14-16, 2010.
- [C14] <u>A. Ambikapathi</u>, T.-H. Chan, W.-K. Ma, and C.-Y. Chi, "A robust minimum-volume enclosing simplex algorithm for hyperspectral unmixing," in *Proc. IEEE ICASSP*, Texas, Mar. 14-19, 2010, pp. 1202-1205.
- [C15] T.-H. Chan, W.-K. Ma, C.-Y. Chi, and <u>A. Ambikapathi</u>, "Hyperspectral unmixing from a convex analysis and optimization perspective," in *Proc. First IEEE WHISPERS*, France, Aug. 26-28, 2009, pp. 1-4. (Invited paper)

Technical Reports:

- [T1]. <u>A. Ambikapathi</u> and C.-Y. Chi, ``Advanced and Reliable Blind Source Separation for biomedical, hyperspectral and genomic image Analysis," National Science Council Project (NSCP), Mid-term Report, National Tsing Hua Univ. (NTHU), Taiwan, May, 2014.
- [T2]. <u>A. Ambikapathi</u> and C.-Y. Chi, ``Evaluation of Treatment Response in Patients with Liver cancer via Pharmacokinetic Analysis in DCE-MRI," NTHU and Mackay Memorial Hospital Project, Final Report, NTHU, Taiwan, March, 2014.
- [T3]. <u>A. Ambikapathi</u> and C.-Y. Chi, ``Early-stage Prostate Cancer Detection Using Advanced DCE-MR Image Analysis," NTHU and Mackay Memorial Hospital Project, Final Report, NTHU, Taiwan, April, 2013.
- [T4]. <u>A. Ambikapathi</u> and C.-Y. Chi, ``Advanced Blind Source Separation for Biomedical and Hyperspectral Image Analysis," National Science Council Project, Final Report, NTHU, Taiwan, Dec. 2013.
- [T5]. <u>A. Ambikapathi</u>, "Chance Constrained Robust Unmixing Algorithms and Estimation of Number of Endmembers in Hyperspectral Images," Ph.D. dissertation, National Tsing Hua Univ., Taiwan, Aug., 2011.

RESUME OF Dr. ARULMURUGAN AMBIKAPATHI Invited Technical Talks:

[I1]. <u>A. Ambikapathi,</u> ``BSS and Recent Deep Learning Applications," Talk at NTU, Singapore, 3 Feb., 2017.

[I2]. <u>A. Ambikapathi,</u> "Theory and Applications of Convex Optimization," Special Invited Talk at Dept. of Mathematics, SRC College, Tiruchirappalli, India, 11 Feb., 2016.

[I2]. <u>A. Ambikapathi</u>, ``Scintillating Applications of Convex Optimization: From Satellite Image Analysis to Earlystage Cancer Detection," Invited talk in Dept. of Mechanical Engineering, National Taiwan University of Science and Technology, Taipei, Taiwan, 22 Dec., 2015.

[I3]. <u>A. Ambikapathi</u>, ``Blind Source Separation and Convex Optimization (Application: Early-stage Cancer Detection)," Invited talk on Computer vision, at National Taiwan University of Science and Technology, Taipei, Taiwan, 5 May, 2015.

[I4]. <u>A. Ambikapathi</u>, "Robust Blind Source Separation for Hyperspectral Unmixing," Invited talk at Dept. of Electrical Engineering, Yuanze University, Taoyuan, Taiwan, 29 Nov., 2013.

[I5]. <u>A. Ambikapathi</u>, ``Convex Geometry Based Estimation of Number of Sources in Hyperspectral Images," Invited talk (A) at Dept. of Electrical Engineering, Yuanze University, Taoyuan, Taiwan, 11 Oct., 2013.

[I6]. <u>A. Ambikapathi</u>, ``Blind Source Separation and Convex Optimization Application: Early-stage Cancer Detection," Invited talk (B) at Dept. of Electrical Engineering, Yuanze University, Taoyuan, Taiwan, 11 Oct., 2013.

[I7]. <u>A. Ambikapathi</u>, ``Hyperspectral Data Geometry Based Estimation of Number of Endmembers Using p-norm Based Successive Pure Pixel Identification Algorithm," at Institute Seminar of Dept. of ICE, National Tsing Hua University, Hsinchu, Taiwan, 12 Oct., 2012.

COMPUTER PROFICIENCY				
Programming ability	:	MATLAB, C# .NET, C++, OPENCV, CVX, SeDuMi, ALP, TMS320C67X.		
Platform used	:	WINDOWS.		
Other Packages known	: LaTe	Caffe, E-Vision Easy Access, Code Composer Studio 3.1, Visual Studio, X, Mayura.		

ACADEMIC PROFILE

CLASS	NAME OF THE INSTITUTION	BOARD OF STUDY	YEAR OF COMPLETION	PERCENTAGE / CGPA
Ph.D. (Commn. Eng.)	National Tsing Hua University, Taiwan	NTHU, Taiwan	2011	86.3
M.E. (Commn. Sys.)	Mepco Schlenk Engineering College, India	Anna University	2005	88.5
B.E. (ECE)	J.J College of Engg. & Technology, India	Bharathidasan University	2003	87.2
HSC	St.Thomas Matriculation higher secondary school, India	State board	1999	92.5
SSC	St.Thomas Matriculation higher secondary school, India	Matriculation	1997	86.7

LIST OF THESES

- B.E. Project Report: "Adaptive Interference Suppression in CDMA Systems," at National Aerospace Lab. (NAL) Bangalore, Karnataka, INDIA, June 2003.
- M.E. Thesis: "Medical Image Analysis using Fuzzy and Genetics, FuGe Algorithm (A.I)," at Mepco Schlenk Eng. Col., TamilNadu, INDIA, June 2005.
- Ph.D. Thesis: "Chance Constrained Robust Unmixing Algorithms and Estimation of Number of Endmembers in Hyperspectral Images", at National Tsing Hua University (NTHU), TAIWAN, Aug. 2011.

ACADEMIC EXPOSURE, MAJOR JOURNALS REVIEW, & MEMBERSHIPS

- * Reviewer of IEEE Transactions on Image Processing
- Reviewer of IEEE Transactions on Signal Processing
- * Reviewer of IEEE Signal Processing Letters
- ***** Reviewer of **IEEE Transactions on Geoscience and Remote Sensing**
- * Reviewer of IEEE Geoscience and Remote Sensing Letters
- * Reviewer of IEEE Journal of Selected Topics in Applied Earth Observation and Remote Sensing
- * Reviewer of SPIE Journal of Applied Remote Sensing
- * Reviewer of SPIE Journal of Biomedical Optics
- * Reviewer of Elsevier: Pattern Recognition Letters
- Member of **IEEE** Association, New Jersey, U.S.A (from 2002 till date).
- ✤ Life Member of ISTE (Indian Society for Technical Education).
- ✤ Life Associate Member of IETE (Inst. of Electronics and Telecommn. Engineers).

PERSONAL DETAILS

Father's Name	: Er. E. AMBIKAPATHI, B.E., M.I.E.,
Name of Spouse	: NIRAIMATHI
Name of son	: AKSHAY ARUL
Current Designation	: <i>Team Lead</i> , UTECHZONE CO. Ltd., Taiwan (Since Sep. 2014)
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Languages	: Read, Write & Speak : English (TOEFL: 95/120), Tamil, Hindi. Basic Mandarin.

I, A. ARULMURUGAN do hereby confirm that the information given above are true to the best of my knowledge.

Date: July 2017 Place: UTECHZONE Co. Ltd., Taiwan

ArulMurugan Ambikapathi

References (Industrial Research & Development):

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Dr. Tsung-Han Chan Ph.D.,

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References (Academic Research):

Prof. Bormin Huang.,
NVIDIA CUDA Fellow and SPIE Fellow
Professor, University of Wisconsin-Madison,
Director, Intel Parallel Computing Center at the University of Wisconsin-Madison
Overseas Chair Professor, Xidian University
International Chair Professor, Taipei University of Technology
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