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**2020 Joint 9th International Conference on
Informatics, Electronics and Vision (ICIEV)
*and***

**2020 4th International Conference on
Imaging, Vision & Pattern Recognition (icIVPR)
*with***

**2nd International Conference on
Activity and Behavior Computing (ABC)**

26 August ~ 29 August, 2020 | Kitakyushu, Japan



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**Joint 2020 9th International Conference on Informatics, Electronics and Vision (ICIEV)
&
4th International Conference on Imaging, Vision & Pattern Recognition (IVPR)
with
International Conference on Activity and Behavior Computing (ABC)**

Venue: Kitakyushu International Conference Center, Kitakyushu, Fukuoka, Japan

Date: 26 August ~ 29 August 2020

Honorary General Chair of 9th ICIEV:

Toshio Fukuda, IEEE President 2020, IEEE Life Fellow, Meijo University, Japan; Beijing Institute of Technology, China

General Chairs of 9th ICIEV:

Michihiko Minoh, Executive Director, RIKEN; Kyoto University, Japan

Matthew Turk, Fellow-IEEE, IAPR, President, Toyota Technological Institute at Chicago, USA

Md Atiqur Rahman Ahad, SMIEEE, University of Dhaka, Bangladesh; Osaka University, Japan

General Co-chair:

Atsushi Inoue, Eastern Washington University, USA

General Chairs of 4th IVPR:

Toshio Fukuda, IEEE President 2020, IEEE Life Fellow, Meijo University, Japan; Beijing Institute of Technology, China

Md Atiqur Rahman Ahad, SMIEEE, University of Dhaka, Bangladesh; Osaka University, Japan

General Chairs of 2nd ABC:

Sozo Inoue, Kyushu Institute of Technology, Japan; RIKEN, Japan

Md Atiqur Rahman Ahad, SMIEEE, University of Dhaka, Bangladesh; Osaka University, Japan

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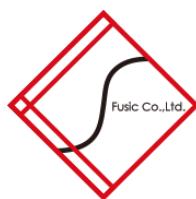
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Call for Paper:

Journal (FREE to publish & access):

International Journal on Computer Vision & Signal Processing (IJCVSP)
<http://cennser.org/IJCVSP>

Welcome Message

It is my great pleasure to welcome to the *Joint 2020 9th International Conference on Informatics, Electronics & Vision (ICIEV)*, and *4th International Conference on Imaging, Vision & Pattern Recognition (IVPR)*, along with the *2nd International Conference on Activity and Behavior Computing (ABC)* to be held in Kokura, Kitakyushu, Japan. Earlier, ICIEV was held in Bangladesh (four times) and Japan (three times), and USA (in 2019) with very good success. The IVPR was organized in Bangladesh, Japan, and USA.

IEEE, IEEE Computer Society, IEEE TCPAMI, etc. are part of the success of ICIEV/IVPR. ABC papers are published in Springer as book chapter (to be archived in SCOPUS index and others). There is a Cooking Activity Challenge and accepted submissions are published as book chapters in Springer (to be archived in SCOPUS and others). Both books are in press now. We thank IEEE, IEEE CS, IEEE TCPAMI, IEEE CS Bangladesh chapter, Center for Natural Science & Engineering Research (CNSER), Kitakyushu International Conference Center, 6 sponsors (Mamezou Co., Ltd; Innovation Plus Co., Ltd.; Fusic Co., Ltd.; SMART Co., Ltd.; Liful Co., Ltd.; and CARECOM Co., Ltd.), the committee members, reviewers, excellent & dynamic volunteers for their efforts. Special thanks to City of Kitakyushu and Kitakyushu Convention and Visitors Association. We are very grateful for the extensive efforts of many individuals who worked diligently to ensure a successful, high quality conference. Without the hard work and dedication of all these volunteers, the conference could not be successful. We would like to thank the 4 distinguished keynote speakers for their supports and participations.

This list of co-sponsors indicates the broad involvement and support for the conference. We wholeheartedly thank the committee members, especially the Sozo Inoue, Mazakazu Morimoto, Daniel Roggen, Kaori Fujinami, MAS Kamal, Upal Mahbub, Atsushi Inoue, and others. We would like to specially thank the Secretaries – Ahsan Habib (MBSTU), and Sozo Lab. members of Kyushu Institute of Technology, for their tremendous commitment and supports for a long period for these conferences. Most importantly, we wish to thank all of the authors who are sharing research results at the conference and who are collectively pushing forward the state of the art in these important areas.

Due to covid-19, we could not have all participants (from more than 25 countries). In 2021, we will organize the 10th ICIEV and 5th IVPR in the green city – the Kitakyushu, Japan. The 3rd ABC is planned to be in Thailand in 2021. We wholeheartedly welcome you all to attend the conferences and be a dedicated part of the them. 10th year of ICIEV should be a great gathering with high-quality papers. Please inform others to submit quality papers in these conferences. We invite the attendees to actively participate in the conference activities, and to enjoy the opportunity to learn from one another (on-site or online). We hope to have your cordial support and participation in future conferences.

Honorary General Chair of 9th ICIEV:

Toshio Fukuda, *IEEE President 2020, LFIEEE, Meijo University, Japan; Beijing Institute of Technology, China*
General Chairs of 9th ICIEV:

Michihiko Minoh, *Executive Director, RIKEN; Kyoto University, Japan*

Matthew Turk, *Fellow-IEEE, IAPR, President, Toyota Technological Institute at Chicago, USA*

Md Atiqur Rahman Ahad, *SMIEEE, University of Dhaka, Bangladesh; Osaka University, Japan*

General Co-chair:

Atsushi Inoue, *Eastern Washington University, USA*

General Chairs of 4th IVPR:

Toshio Fukuda, *IEEE President 2020, IEEE Life Fellow, Meijo University, Japan; Beijing Institute of Technology, China*

Md Atiqur Rahman Ahad, *SMIEEE, University of Dhaka, Bangladesh; Osaka University, Japan*

General Chairs of 2nd ABC:

Sozo Inoue, *Kyushu Institute of Technology, Japan; RIKEN, Japan*

Md Atiqur Rahman Ahad, *SMIEEE, University of Dhaka, Bangladesh; Osaka University, Japan*

Welcome Message from Program Chairs (ICIEV-IVPR 2020)

Welcome to the Joint 9th International Conference on Informatics, Electronics & Vision (ICIEV) and the 4th International Conference on Imaging, Vision & Pattern Recognition (IVPR), 2020 in the wonderful city of Kitakyushu, Fukuoka, Japan. We consider ourselves very fortunate to be able to organize these conferences with provisions for both onsite and online participation during the COVID-19 pandemic. The program contains 4 Keynote Talks, 13 paper sessions and one industry session. We truly believe that this conference will provide the participants a great opportunity to share the research ideas and outcomes, and enhance the networking for future collaboration at the international level.

This joint conference has attracted a total of 225 paper submissions - 133 in the IVPR track and 92 in the ICIEV track. After several stages of rigorous reviews, 56 papers (IVPR - 35, IEV - 21) have been included in the technical program for presentation and publication in the conference proceedings. The review process was conducted by our expert technical committee members and the other qualified reviewers. Each paper was reviewed by at least two reviewers (to at most 8 reviewers), and some papers were reviewed in two stages to ensure the quality (average review per paper is 3+). Furthermore, all papers were checked by IEEE's plagiarism checker for originality a couple of times. We have received papers from various institutes and universities in 26 different countries from all over the world - most notably from Australia, Austria, Belgium, Bangladesh, Cambodia, Canada, China, Colombia, France, Germany, India, Italy, Japan, Macedonia, Malaysia, Philipines, Slovenia, Singapore, Sweden, Taiwan, Thailand, The Netherlands, Tunisia, Turkey, UK, and USA.

We would again like to emphasize on the challenges that we faced due to the worldwide pandemic when organizing these conferences. For us, a driving force was the tremendous enthusiasm and support from the authors, volunteers, committee members and participants towards organizing and attending the conferences in-person or online. Our heartiest gratitude goes to the reviewers who put extraordinary efforts to complete the reviews despite their busy schedule and hardship due to COVID-19. The reviews played an instrumental role in selecting high quality papers and, thereby, maintaining the standards for the conference program. We are also thankful to the honorable keynote speakers for sharing their vast expertise with all the participants of the conference. That the participants will undoubtedly benefit from the insightful talks and stimulating discussion sessions. Finally, we would like to thank all the authors, organizing committee members, and volunteers for their great unconditional support all along.

For Best Paper Award, we have engaged about 100 experts (including IEEE Fellows) after several screening to short-list some papers. Then based on the scores, we selected the best papers. A few papers have been selected for the *International Journal of Computer Vision and Pattern Recognition* (IJCVSP) and book chapters, to be published in Springer. A few papers are selected as non-archival / work-in-progress (WIP). We hope that this joint conferences will be a wonderful learning and networking experience for all of us and will be cherished as a lasting pleasant memory amidst the dreadful pandemic.

Program Chairs of ICIEV & IVPR, 2020

Sozo Inoue, *Kyushu Institute of Technology, Japan*
MAS Kamal, *Gunma University, Japan*
Anca L. Ralescu, *University of Cincinnati, USA*
Upal Mahbub, *Qualcomm Technologies Inc., USA*

Message on 2nd ABC

The second edition of the International Conference on Activity and Behavior Computing (ABC'2020) will be held in a virtual format (and partially onsite for those who will be able to attend), given the unprecedented circumstances in this year 2020. This year's edition also has a novel proceedings format, whereby the papers selected for publication appear as chapters within this book.

The Activity and Behavior Computing conference aims to be a venue to discuss the many facets of computing systems which are able to sense, recognize and eventually understand human activities, behaviors, and the context within which they occur. This in turn enables a wide range of applications in a large variety of disciplines. As such, this conference reflects a broad range of topics, which will be reflected in the following pages. In particular, the contributions received this year reflect *Algorithms and Methods*, *Devices and Systems* and *Applications*, and the organization of this volume reflects this.

Despite the challenging worldwide situation, we are extremely pleased to have received 30 submissions, of which 18 were selected for publication. Every submission was peer reviewed in a double-blind format and received at least 3 reviews. The program chairs along with the general chairs had rigorous meeting to decide the fate of the papers at the 1st round. After the rebuttals, another meeting was arranged and the final decisions are made. Even after the final decision, the program committee did a few stages of minor editing for some papers to enrich the quality of the chapters. The resulting selection of papers reflects the broad interests of this nascent community and is important to take stock of the state of the art and continued research challenges in the field.

We wish to thank the contributions of all the authors to this conference, and also all the reviewers. It is thanks to the passion for research of our authors and the dedication of reviewers that we could put together this volume.

Finally, we would like to thank all the remaining people involved in the process of setting up this conference and publishing this book: besides the General Chairs and Program Chairs, this includes as well our publicity chair Brahim Benissa, our publication chair Paula Lago, the secretaries at Kyushu Institute of Technology (Tahera Hossain, Moe Matsuki, Nattaya Mairittha, and Tittaya Mairittha), the members of the advisory board and the program committee.

Finally, we hope you will find this volume as interesting to read as it was for us to put it together. We hope that you will find the content stimulating, highlighting areas of progress as well as outlining areas that are still in need of further research. We hope that we may see the fruits of your own work, informed by this book, in future editions of ABC.

Program Chairs

Daniel Roggen, *University of Sussex, UK*

Kaori Fujinami, *Tokyo University of Agriculture and Technology, Japan*

General Chairs

Sozo Inoue, *Kyushu Institute of Technology, Japan*

M.A.R. Ahad, *University of Dhaka, Bangladesh; Osaka University, Japan*

FINAL Program at a glance (Japan Standard Time (JST))

<i>Day 1: 26 August</i>	<i>Begin</i>	<i>Name of the Event, Paper ID</i>
	1200	Opening Ceremony
	1215	IVPR-1: Generator: 168, 16, 26, 3, 97
	1330	Coffee Break
	1340	IEV-1: Data Mining & Informatics: 209, 179, 255, 164, 239, 218
	1510	Coffee Break
	1520	Keynote Speech 1: AI and Psychology, Michihiko Minoh, RIKEN
	1605	Break
	1610	IVPR-2: 3D Vision: 229, 21, 22, 185, 211, 220
	1740	Coffee Break
	1750	ABC-1: Activity & Behavior Analysis: 88, 181, 194, 74, 126, 189
	1920	Networking (From 1920 ~ 2000)
<i>Day 2: 27 August</i>		
	1200	IEV-2: Machine Learning: 210, 156, 103, 54, 177, 90
	1330	Break
	1335	Keynote Speech 2: Eye Movement Detection Sensors, Biometrics, and Health Assessment, Oleg Komogortsev, Texas State University
	1420	Coffee Break
	1430	IVPR-3: Algorithms: 17, 18, 34, 128, 222, 224
	1600	Coffee Break
	1610	Industry Session
	1740	Coffee Break
	1750	ABC-2: Activity Analysis: Device & Systems: 187, 150, 39, 149, 139, 155
	1920	WIP-1: 144, 216, 260, 217, 166, 253, 136, 271 (From 1920 ~ 2020)
<i>Day 3: 28 August</i>		
	1200	IEV-3: Information System: 169, 106, 99, 85, 243, 41
	1330	Break
	1335	Keynote Speech 3: Security and Privacy Challenges in Learning-enabled IoT Systems, Mani Srivastava, University of California, LA
	1420	Coffee Break
	1430	IVPR-4: Vision & Imaging: Applications: 140, 157, 240, 13, 32, 225
	1600	Coffee Break
	1610	IVPR-5: Medical Aspects: 37, 223, 221, 226, 244, 214
	1740	Coffee Break
	1750	Activity & Behavior Analysis: Method: 159, 191, 190, 183, 188, 165
	1920	WIP-2: 107, 145, 182, 238, 59, 186, 152, 192 (From 1920 ~ 2020)
<i>Day 4: 29 August</i>		
	1200	IVPR-6: Vision: Objects: 201, 208, 11, 176, 35, 167
	1330	Coffee break
	1340	IEV-IVPR-4: Communication & System: 58, 158, 147, 215
	1440	Keynote Speech 4: Virtual and Augmented Reality Animals in Smart and Playful Cities, Anton Nijholt, University of Twente
	1525	Coffee break
	1535	Cooking Activity Challenge: 261, 262, 263, 264, 265, 266, 268, 269, 270, 272
	1705	Award & Closing Ceremony (From 1705 ~ 1730)

Time Zone: Japan Standard Time (JST)									
Final Program: 9th ICIEV, 4th IVPR & 2nd ABC, 26-29 August, 2020, Kitakyushu, Japan									
26-Aug	Start	End	Session	Topic	ID	Title	Authors (with affiliations)		
Speakers:									
						Sozo Inoue , General Chair, 2nd ABC; Program Chair, 4th IVPR; Kyushu Institute of Technology, Japan			
	1200	1215	Opening Ceremony			Matthew Turk , General Chair, 9th ICIEV; Fellow, IEEE; Fellow, IAPR; President, Toyota Technological Institute at Chicago, USA; University of California, Santa Barbara, USA			
						Michihiko Minoh , 9th ICIEV; Kyoto University, Japan; Executive Director, RIKEN, Japan			
						Saifur Rahman , Life Fellow, IEEE; Virginia Tech., USA; Advisory Board Member, ICIEV & IVPR 2020			
						Daniel Roggen , Program Chair, 2nd ABC; Sussex University, UK			
	1215	1330	IVPR-1	Generator	168	Synthesizing Cell Protein data for Human Protein Cell Profiling Using Dual Deep Generative Modeling	Rakesh Ranjan (Kyushu Institute of Technology)*; Sozo Inoue (Kyushu Institute of Technology); Tomohiro Shibata (Kyushu Institute of Technology)		
					16	Early Pulmonary Embolism Detection from Computed Tomography Pulmonary Angiography Using Convolutional Neural Networks	Ching-Yuan Yu (National Chiao-Tung University)*; Chin Kuo (National Cheng Kung University Hospital, College of Medicine, National Cheng Kung University); Yun-Chien Cheng (National Chiao-Tung University)		
					26	AdversarialQR: An adversarial patch in QR code format	Aran Chindaudom (Mahidol University)*; Prarinya Siritanawan (Japan Advanced Institute of Science and Technology); Karin Sumongkayothin (Mahidol University); Kazunori Kotani (Japan Advanced Institute of Science and Technology)		
					3	Deep Learning with AnoGAN and Efficient GAN to Judge Agricultural Harvest Image Data	Shinji KAWAKURA (Osaka City University)*; Ryosuke Shibusaki (University of Tokyo)		
					97	PerceptionGAN: Real-world Image Construction from Provided Text through Perceptual Understanding	Kanish Garg (Indian Institute of Technology, Delhi)*; Ajeeet Singh (IIT DELHI); Dorian Herremans (Singapore University of Technology and Design); Brejesh Lall (IIT Delhi)		
1330	1340	Coffee-1							
1340	1510	IEV-1	Data Mining & Informatics	209	Anomaly Detection using Variational Autoencoder with Spectrum Analysis for Time Series Data	Umaporn Yokkampon (Kyushu Institute of Technology)*			
				179	IntellCache: An Intelligent Web Caching Scheme for Multimedia Contents	Nishat Niloy (University of Dhaka)*; Md. Shariful Islam (University of Dhaka)			
				255	Forecasting the Risk of Type II Diabetes using Reinforcement Learning	Most. Fatematu Zohora (Jahangirnagar University); Marzia Tania (Bangladesh University of Professionals); Shamini Kaiser (Jahangirnagar University)*; Mufti Mahmud (Nottingham Trent University, Nottingham)			
				164	Hybrid Text Summarizer for Bangla Document	Mahimul Islam (Ahsanullah University of Science and Technology); Fariba Nuzhat Majumdar (Ahsanullah University of Science and Technology); Asadullahil Galib (Ahsanullah University of Science and Technology); Md Moinul Hoque (Ahsanullah University of Science and Technology)*			
				239	Knowledge-Base Optimization to Reduce the Response Time of Bangla Chatbot	Md. Kowsler (Noakhali Science and Technology University)*; Anik Tahabilder (PUST); Md. Zahidul Islam Sanjui (BRAC University); Nusrat Jahan Prottasha (Daffodil International University); Md. Murad Hossain Sarker (Comilla University)			
				218	A learning mechanism for BRBES using enhanced Belief Rule-Based Adaptive Differential Evolution	Raihan Ul Islam (Luleå University of Technology)*; Mohammad Shahadat Hossain (University of Chittagong); Karl Andersson (Luleå University of Technology)			
1510	1520	Coffee-2							
1520	1605	Keynote 1		Michihiko Minoh , Kyoto University, Japan; Executive Director, RIKEN, Japan (Title: AI and Psychology)					
1605	1610	Break 5min							
1610	1740	IVPR-2	3D Vision	229	Towards Detailed 3D Modeling: Mesh Super-Resolution via Deformation	Ryo Tamura (Aoyama Gakuin University)*; Seiya Ito (Aoyama Gakuin University); Naoshi Kaneko (Aoyama Gakuin University); Kazuhiko Sumi (Aoyama Gakuin University)			
				21	Object Detection in 3D Point Clouds via Local Correlation-Aware Point Embedding	Chengzhi Wu (Karlsruhe Institute of Technology)*; Julius Pfrommer (Fraunhofer IOSB); Jürgen Beyerer (Fraunhofer IOSB); kangning Li (Karlsruhe Institute of Technology); Boris Neubert (Karlsruhe Institute of Technology)			
				22	New Graph Embedding Approach for 3D Protein Shape Classification	Kamel Madi (UMANIS)*; Eric Paquet (National Research Council)			
				185	Performance Evaluation of Markerless 3D Skeleton Pose Estimates with Pop Dance Motion Sequence	Rollyn Labuguen (Kyushu Institute of Technology)*; Tomohiro Shibata (Kyushu Institute of Technology); Salvador Blanco Negrete (Kyushu Institute of Technology); Tomari Kogami (Kyushu Institute of Technology); Wally Enrico M. Ingco (Ateneo de Manila University)			
				211	Feature Bridging Networks for 3D Human Body Shape Estimation from a Single Depth Map	Naoshi Kaneko (Aoyama Gakuin University)*; Mei Oyama (Ricoh Company, Ltd.); Masaki Hayashi (Keio University); Seiya Ito (Aoyama Gakuin University); Kazuhiko Sumi (Aoyama Gakuin University)			
				220	Two-Stream 3D Convolution Attentional Network for Action Recognition	Raden Hadapiningsyah Kusumoseniarto (National Taiwan University of Science and Technology)*			

				Coffee-3		
1740	1750					
1750	1920	ABC-1	Activity & Behavior Analysis	88	A Basic study on Ballroom Dance Figure Classification with LSTM Using Multi-modal Sensor	Hitoshi Matsuyama (Nagoya University)*; Kei Hiroi (Kyoto University); Katsuhiko Kaji (Aichi Institute of Technology); Takuro Yonezawa (Nagoya University); Nobu Kawaguchi (Nagoya University)
				181	Reducing Energy Consumption by Behavioural Change – It is possible!	Dietrich Albert (University of Graz & Graz University of Technology)*; Michael Bedek (University of Graz & Graz University of Technology); Wolfgang Horn (Horn Consult, Leibnitz)
				194	Estimation of Record Contents for Automatic Generation of Care Records	Haru Kaneko (Kyushu Institute of Technology); Tahera Hossain (Kyushu Institute of Technology)*; Sozo Inoue (Kyushu Institute of Technology)
				74	Biological and Behavioral Information-based Method of Predicting Listener Emotions toward Speaker Utterances during Group Discussion	Motoki Sakai (Tokyo Denki University)*; Masaki Shuzo (Tokyo Denki University); Masahide Yuasa (Shonan Institute of Technology); Kanai Matsui (Tokyo Denki University); Eisaku Maeda (Tokyo Denki University)
				126	Investigating Correlations Between Usage of Communication Apps and Instant Messenger and a Smartphone User's Extraversion	Anja Exler (Karlsruhe Institute of Technology)*; Tobias Hornberger (Karlsruhe Institute of Technology); Michael Beigl (Karlsruhe Institute of Technology)
				189	Multilabel Classification of Nursing Activities in a Realistic Scenario	Farina Faiz (Kyushu Institute of Technology)*; Yoshinori Ideno (CARECOM CO., LTD); Hiromichi Iwasaki (University of Fukui Hospital); Yoko Muroi (University of Fukui Hospital); Sozo Inoue (Kyushu Institute of Technology)
1920	1945				Networking	

27-Aug

1200	1330	IEV-2	Machine Learning	210	Visual Analytics for Anomaly Classification in LAN Based on Deep Convolutional Neural Network	Yuwei Sun (The University of Tokyo)*; Hiroshi Esaki (University of Tokyo, Japan); Hideya Ochiai (The University of Tokyo)
				156	Mutual Information based Feature Selection for Nurse Care Activity Recognition	Md. Hasan Tarek (University of Dhaka)*; Md. Eusha Kadir (University of Dhaka); Mahir Mahbub (University of Dhaka); Pritom Saha Akash (University of Dhaka); Amin Ahsan Ali (Independent University Bangladesh); Mohammad Shoaib (University of Dhaka)
				103	Pathfinder: A Fog Assisted Vision-Based System for Optimal Path Selection of Service Robots	Niloy Irtisam (University of Dhaka)*; Riad Ahmed (University of Dhaka); Mohammad Moniruzzaman Akash (University of Dhaka); Raiyaan Abdullah (University of Dhaka); Sujan Sarker (University of Dhaka); Sejuti Rahman (University of Dhaka); Lafifa Jamal (University of Dhaka)
				54	An Improved Adaptive Optimization Technique for Image Classification	Nazmus Saqib (KUET)*; Fatema Tuz Zahra (KUET)
				177	An Integrated Real-Time Deep Learning and Belief Rule Base Intelligent System to Assess Facial Expression under Uncertainty	Tawsin Uddin Ahmed (University of Chittagong)*; Mohammad Newaj Jamil (University of Chittagong); Mohammad Hossain (University of Chittagong); Karl Andersson (Luleå University of Technology); Sazzad Hossain (University of Liberal Arts Bangladesh)
				90	Alzheimer's Disease Prediction Using Convolutional Neural Network Models Leveraging Pre-existing Architecture and Transfer Learning	Mahjabeen Tamanna Abed (BRAC University); Umme Fatema (BRAC University); Shanewas Ahmed Nabil (BRAC University); Md. Ashraful Alam (BRAC University); Md Tanzim Reza (BRAC University)*
1330	1335				Break 5min	
1335	1420		Keynote 2		Oleg Komogortsev, Texas State University, USA; Presidential Early Career Award for Scientists and Engineers (PECASE) 2017 (Title: Eye Movement Detection Sensors, Biometrics, and Health Assessment)	
1420	1430	Coffee-4				
1430	1600	IVPR-3	Algorithms	17	Multi-branch Semantic Segmentation Network	LiHua Wei (Inner Mongolia University); Yingdong Ma (Inner Mongolia University)*
				18	Multi-Level Feature and Context Pyramid Network for Object Detection	Xia Wang (Inner Mongolia University); Yingdong Ma (Inner Mongolia University)*
				34	A Warp Speed Chain-Code Algorithm Based on Binary Decision Trees	Stefano Allegretti (Università degli Studi di Modena e Reggio Emilia)*; Federico Boletti (Università degli Studi di Modena e Reggio Emilia); Costantino Grana (University of Modena and Reggio Emilia)
				128	The Planar/Hyper-Planar Rotated Polar Coordinate System and Its Mathematical Solid Vector Addition, Multiplication, Division, Dot Product and Cross Product Operations	Jalal Al-Anssari (University of Cincinnati)*; Inam Naser (University of Cincinnati); Anca Ralescu (University of Cincinnati)
				222	Visual Attention: Deep Rare Features	Matei Mancas (U Mons/itention)*; Phutphalla Kong (Institute of Technology of Cambodia); Bernard Gosselin (Université de Mons (UMONS))
				224	Second-Order Estimation Based Attention Network for Metric Learning	Zeyu Sun (Waseda University)*; Sci-ichiro Kamata (Waseda University)
1600	1610				Coffee-5	
1610	1740	Industry Session			Mamezou Co., Ltd. Innovation Plus Co., Ltd. Fusic Co., Ltd. Smart Co., Ltd. Liful Co., Ltd. Carecom Co., Ltd.	
1740	1750				Coffee-6	

1750	1920	ABC-2	Activity Analysis: Devices & Systems	187	Exploring Human Activity by Using eSense Earable Device	Md Shafiqul Islam (Kyushu Institute of Technology)*; Tahera Hossain (Kyushu Institute of Technology); M.A.R. Ahad (University of Dhaka); Sozo Inoue (Kyushu Institute of Technology)
				150	Head-AR: Human Activity Recognition with Head Mounted IMU Using Weighted Ensemble Learning	Hristijan Gjoreski (Ss. Cyril and Methodius University)*; Ivana Kiprijanova (Institute Jozef Stefan); Simon Stankoski (Institute Jozef Stefan); Stefan Kalabakov (Institute Jozef Stefan); John Broulidakis (Emteq Ltd.); Charles Nduka (Emteq Ltd.); Martin Gjoreski (Institute Jozef Stefan)
				39	In-shoe motion sensor for initial contact and toe-off event detection	Chenhai Huang (NEC)*; Kenichiro Fukushi (NEC); Zhenwei Wang (NEC); Hiroshi Kajitani (NEC); Fumiuki Nihey (NEC); Kentaro Nakahara (NEC)
				149	Classification Method of Eating Behavior by Dietary Sound Collected in Natural Meal Environment	Haruka Kamachi (Aoyama Gakuin University)*; Takumi Kondo (Aoyama Gakuin University); Anna Yokokubo (Aoyama Gakuin University); Guillaume Lopez (Aoyama Gakuin University)
				139	Human Pose Tracking by Fusing Human Joint Positions from Multiple Kinect 3 : New Results	Jessica Colombe (Inria)*; David Daney (Inria); Vincent Bonnet (Univ Paris Est Creteil, LISSI); Francois Charpillet (Inria)
				155	ExerSense: Real-Time Physical Exercise Segmentation, Classification, and Counting Algorithm Using an IMU Sensor	Shun Ishii (Aoyama Gakuin University)*; Kizito Nkurikiyezu (Aoyama Gakuin University); Mika Luimula (Turku University of Applied Sciences); Anna Yokokubo (Aoyama Gakuin University); Guillaume Lopez (Aoyama Gakuin University)
1920	2020	Work-in-progress (WIP)-1		144	Glioma Histopathological Images Classification with Deep CNN and Object Level Features	Daisuke Saito (Mie University)*; Hiroharu Kawanaka (Mie University); Shinji Tsuruoka (Mie University); Bruce J. Aronow (Cincinnati Children's Hospital Medical Center); V. B. Surya Prasath (Cincinnati Children's Hospital Medical Center)
				216	The Measurement of bio medical reaction of the VR motion sickness in elderly subjects	Yutaka Yoshida (Nagoya City University)*; Emi Yuda (Tohoku University); Norihiro Ueda (Nagoya City University); Junichiro Hayano (Nagoya City University); Itaru Kaneko (Nagoya City University)
				260	On the Elliptical Ring-canal of Starfish Routing	Md Ahsan Habib (University of Dhaka)*; Sajeeb Saha (Jagannath University); Md Abdur Razzaque (University of Dhaka); Md. Mamun-Or- Rashid (University of Dhaka)
				217	Relation between frequency of opening and closing of vascular and area of skin by microvascular wave	Yutaka Yoshida (Nagoya City University)*; Emi Yuda (Tohoku University); Yutaka Miura (Shigakkan University); Norihiro Ueda (Nagoya City University); Junichiro Hayano (Nagoya City University); Itaru Kaneko (Nagoya City University)
				166	Development of Electrical Impedance Imaging System for Continuous Monitoring of Lung Diseases	Aniqa Tabassum (University of Dhaka)*; Md. Adnan Kiber (University of Dhaka)
				253	Development of an optimal signal control method for the next-generation traffic at intersections	Makoto Hasegawa (Gunma University)*; MAS Kamal (Gunma University); Kotaro Hashikura (Gunma University); Kou Yamada (Gunma University)
				136	Development of Cytology Support System using Machine Learning Methods	Hiroki Kiyose (University of Hyogo)*
				271	Hand detection in UKA surgery videos using Deep Convolutional Neural Network	Shadman Sakib (University of Hyogo)*; Belayat Hossain (University of Hyogo); Takafumi Hiranaka (Takatsuki General Hospital); Syoji Kobashi (University of Hyogo)
Question-Answer Session for All WIP-1						

28-Aug

1200	1330	IEV-3	Information System	169	Static Output Feedback Control Design for Takagi-Sugeno Descriptor Fuzzy Systems	Jun Yoneyama (Aoyama Gakuin University)*
				106	Simulation of Pattern Formation of Swarm with Minimum Shape Parameters	Md. Tahmeed Abdullah (University of Dhaka)*; Md Jubair Ahmed (University of Dhaka); Sejuti Rahman (University of Dhaka); Sujan Sarker (University of Dhaka)
				99	Attack Detection in Internet of Things using Software Defined Network and Fuzzy Neural Network	Fahiba Farhin (Jahangirnagar University); Ishrat Sultan (Jahangirnagar University); Nahida Islam (Jahangirnagar University); Md Sazzadur Rahman (Jahangirnagar University); Shamim Kaiser (Jahangirnagar University)*; Mufti Mahmud (Nottingham Trent University, Nottingham)
				85	Water Quality Classification Using Data Mining Techniques: A Case Study on Wang River in Thailand	Krittakom Srijiranan (Thammasat University)*; Kittichai Northerp (Thammasat University); Narissara Eiamkanitha (Chiang Mai University)
				243	Lemmatization Algorithm Development for Bangla Natural Language Processing	Md. Kowsler (Noakhali Science and Technology University)*; Anil Tahabilder (PUST); Md. Murad Hossain Sarker (Comilla University); Md. Zahidul Islam Sanjid (BRAC University); Nusrat Jahan Prottasha (Daffodil International University)
				41	Inference and Multi-level Learning in a Belief Rule-Based Expert System to Predict Flooding	Raihan Ul Islam (Luleå University of Technology)*; Mohammad Shahadat Hossain (University of Chittagong); Karl Andersson (Luleå University of Technology)
Break 5min						
1335	1420	Keynote 3		Mani Srivastava , University of California, LA, USA; Fellow ACM; Fellow, IEEE (Title: Security and Privacy Challenges in Learning-enabled IoT Systems)		
1420	1430	Coffee-7				

1430	1600	IVPR-4	Vision & Imaging: Applications	140	Analysis of Tourists' Nationality Effects on Behavior-based Emotion and Satisfaction Estimation	Yuki Matsuda (Nara Institute of Science and Technology)*; Dmitrii Fedotov (Ulm University); Yutaka Arakawa (Nara Institute of Science and Technology); Hirohiko Suwa (Nara Institute of Science and Technology); Wolfgang Minker (Ulm University); Keiichi Yasumoto (Nara Institute of Science and Technology)
1600	1610			Coffee-8		
1610	1740	IVPR-5	Medical Aspects	37	A Method for Predicting Dose Distribution of Nasopharyngeal Carcinoma Cases by Multiple Deep Neural Networks	Bilel Daoud (Kyushu University)*; Ken'ichi Morooka (Okayama University); Shoko Miyauchi (Kyushu University); Ryo Kurazume (Kyushu University); Wafa Mnejja (EPS HABIB BOURGUIBA); Farhat Leila (EPS HABIB BOURGUIBA); Jamel Daoud (EPS HABIB BOURGUIBA)
				223	A Review of the Technology of Activity Recognition for Dementia	Muhammad Fikry (Kyushu Institute of Technology)*; Defry Hamdhanah (Kyushu Institute of Technology); Paula Lago (Kyushu Institute of Technology); Sozo Inoue (Kyushu Institute of Technology)
				221	A Coarse to Fine Framework for Multi-organ Segmentation in Head and Neck Images	Yan Pu (Waseda University)*; Sei-ichiro Kamata (Waseda University); Youjie Wang (Waseda University)
				226	Combined Convolutional Neural Network for Highly Compressed Images Denoising	Binying Liu (Waseda University)*; Sei-ichiro Kamata (Waseda University)
				244	A Hybrid Deep Learning Framework using CNN and GRU-based RNN for Recognition of Pairwise Similar Activities	Md. Sadman Siraj (University of Dhaka)*; M.A.R. Ahad (University of Dhaka; Osaka University)
				214	Stain-Refinement and Boundary-Enhancement Weight Maps for Multi-organ Nuclei Segmentation	Ruochan Wang (Waseda University)*; Sei-ichiro Kamata (Waseda University)
1740	1750			Coffee-9		
1750	1920	ABC-3	Activity & Behavior Analysis: Method	159	Accuracy of Motion Estimation using Sparse Set IMUs in Gait Analysis	Tsubasa Maruyama (National Institute of Advanced Industrial Science and Technology)*; Haruki Toda (National Institute of Advanced Industrial Science and Technology); Suguru Kanoga (AIST); Mitsunori Tada (National Institute of Advanced Industrial Science and Technology); Yui Endo (National Institute of Advanced Industrial Science and Technology)
				191	Improving Smartphone based Transport Mode Recognition using Generative Adversarial Networks	Lukas Gunthermann (University of Sussex)*; Daniel Roggen (University of Sussex); Andrew Philppides (University of Sussex)
				190	New Class Candidate Generation applied to On-Body Smartphone Localization	Mitsuaki Saito (Tokyo University of Agriculture and Technology)*; Kaori Fujinami (Tokyo University of Agriculture and Technology)
				183	Mapping Vicon Motion Tracking to 6-axis IMU Data for Wearable Activity Recognition	Lloyd Pellatt (University of Sussex)*; Alex Dewar (University of Sussex); Andrew Philppides (University of Sussex); Daniel Roggen (University of Sussex)
				188	Improvement of Human Action Recognition Using 3D Pose Estimation	Kohei Adachi (Kyushu Institute of Technology)*; Paula Lago (Kyushu Institute of Technology); Tsuyoshi Okita (Kyushu Institute of Technology); Sozo Inoue (Kyushu Institute of Technology)
				165	3D Pose Estimation Using Multiple Asynchronous Cameras	Takashi Morimoto (Hiroshima City University); Ikuhisa Mitsugami (Hiroshima City University)*
1920	2020		Work-in-progress (WIP)-2	107	Towards Automatic Waistline Measurement with A Smartwatch	Yuki Matsuda (Nara Institute of Science and Technology)*; Hugo Nakamura (Nara Institute of Science and Technology)
				145	Drone Control for Monitoring a Walking Person from Constant Distance	Hiroto Yamashita (Hiroshima City University); Takashi Morimoto (Hiroshima City University); Ikuhisa Mitsugami (Hiroshima City University)*
				182	Towards Mapping Activity Classes for Transfer Learning in Human Activity Recognition	Md Shafiqul Islam (Kyushu Institute of Technology)*; Sayeda Shamma Alia (Kyushu Institute of Technology); Sozo Inoue (Kyushu Institute of Technology)
				238	Hardware Trojan for OFDM based Wireless Cryptographic ICs	Farshad Fazle (Bangladesh University of Engineering and Technology)*; Md. Liakot Ali (Bangladesh University of Engineering and Technology)
				59	Data Driven Analysis of the Behaviour of Elderly People Using k-Means and Home Automation and Power Consumption Sensors	Björn Friedrich (Carl von Ossietzky Universität)*; Enno-Eduard Steen (Carl von Ossietzky Universität); Hirohiko Suwa (Nara Institute of Science and Technology); Andreas Hein (Carl von Ossietzky Universität); Keiichi Yasumoto (Nara Institute of Science and Technology)
				186	Towards New Performance Metrics for Multi-level Data for Activity Recognition	Sayedha Shamma Alia (Kyushu Institute of Technology)*; Paula Lago (Kyushu Institute of Technology); Sozo Inoue (Kyushu Institute of Technology)

		152	On Data Augmentation Techniques for Deep Learning Multi-class Segmentation of Lung Confocal Immunofluorescent Images	Daiki Katsuma (Mie University)*; Shu Isaka (Mie University); Hiroharu Kawanaka (Mie University); Bruce J. Aronow (Cincinnati Children's Hospital Medical Center); V. B. Surya Prasath (Cincinnati Children's Hospital Medical Center)
		192	Exploring the use of accelerometer for assisting weight lifting exercise	Nour Alhuda Al bougha (Kyushu Institute of Technology)*; Brahim Benissa (Kyushu Institute of Technology); Sozo Inoue (Kyushu Institute of Technology)
Question-Answer Session for All WIP-2				

29-Aug

	1200	1330	IVPR-6	Vision: Objects	201	Multi-Thread Approach to Object Detection Using YOLOv3	Rayan Abri (Mavinci Informatics Inc.)*; Sara Abri (Mavinci Informatics Inc.); Anil Yarici (Mavinci Informatics Inc.); Salih Çetin (Mavinci Informatics Inc.)
					208	Triplet Network with Multi-level Feature Fusion for Object Tracking	Yang Cao (Xidian University); Bo Wan (Xidian University)*; Quan Wang (Xidian University); Fei Cheng (Xidian University)
					11	BLPNet: An End-to-End Model Towards Voxelization Free 3D Object Detection	Zhihao Cui (University Technology of Sydney)*; zhenhua zhang (University Technology of Sydney)
					176	Deep Learning Based Surface EMG Hand Gesture Classification for Low-Cost Myoelectric Prosthetic Hand	Nazmun Nahid (University of Dhaka); Arafat Rahman (University of Dhaka)*; M.A.R. Ahad (University of Dhaka)
					35	Weakly Supervised Semantic Roadside Object Segmentation Using Digital Maps	Johannes A.P. Guelen (CycloMedia Technology B.V.); Albert Ali Salah (Utrecht University)*; Bas Boom (Cyclomedia); Julien Vijverberg (CycloMedia B.V.)
					167	Polygonization of 3D Objects using Norm Similarity	Somrita Saha (Indian Institute of Engineering Science And Technology, Shibpur)*; Arindam Biswas (IEST Shibpur)
Coffee-10							
	1330	1340			58	Circular Equivalent Planar Array- A new approach	G. M. Asadullah (International Islamic University Malaysia); Md. Shazzadul Islam (International Islamic University Malaysia); Md. Rafiqul Islam (International Islamic University Malaysia)*; Adnan Noor Hidayah M. (International Islamic University Malaysia)
	1340	1440	IEV-IVPR-4	Communication and System	158	Design of High Gain Microstrip Array Antenna and Beam Steering for X Band RADAR Application	Liton Chandra Paul (Pabna University of Science and Technology)*; Md. Ibnu Hasan (Pabna University of Science and Technology); Rezaul Azim (University of Chittagong); Md. Rashedul Islam (Universiti Kebangsaan Malaysia); M. T. Islam (Universiti Kebangsaan Malaysia)
					147	Dissimilarity Based Regularized Deep Learning Model for Information Charts	Prerna Mishra (IIIT-NR, Raipur, CG)*; Santosh Kumar (Dr.S P Mukherjee International Institute of Information Technology) ; Mithilesh Kumar Chaube (IIITNR Raipur)
					215	Suitability of Single-channel Acoustic Myography for Classification of Individual Finger Movements	Amirul Karim Tanim (University of Dhaka)*; K M Talha Nahiyani (University of Dhaka); M.A.R. Ahad (University of Dhaka)
	1440	1525		Keynote 4	Anton Nijholt, University of Twente, The Netherlands (Title: Virtual and Augmented Reality Animals in Smart and Playful Cities)		
Coffee-11							
	1525	1535		Cooking Activity Challenge	261	SCAR-Net: Scalable ConvNet for Activity Recognition with multi-modal Sensor Data	Zabir Al Nazi (MazeGeek, Inc.)*
	1535	1705			262	Multi-class Multi-label Classification for Cooking Activity Recognition	Shkurti Gashi (Università della Svizzera italiana)*; Elena Di Lascio (Università della Svizzera italiana); Silvia Santini (University of Lugano)
					263	Identification of Cooking Preparation Using Motion Capture Data: A Submission to the Cooking Activity Recognition Challenge	Clément Picard (École normale supérieure de Rennes)*; Vito Janko (Jožef Stefan Institute); Nina Reščič (Jožef Stefan Institute); Martin Gjoreski (Institute Jožef Stefan); Mitja Luštrek (Jožef Stefan Institute)
					264	Multi-Sampling Classifiers for the Cooking Activity Recognition Challenge	Ninnart Fuengfusin (Kyushu Institute of Technology)*; Hakaru Tamukoh (Kyushu Institute of Technology)
					265	Activity Recognition from Skeleton and Acceleration Data Using CNN and GCN	Mao Donghui (Shandong University)*
					266	Cooking Activity Recognition with Varying Sampling Rates using Deep Convolutional GRU Framework	Md. Sadman Siraj (University of Dhaka)*; Omar Ibne Shahid (University of Dhaka); M.A.R. Ahad (University of Dhaka)
					268	Deep Convolutional Bidirectional LSTM for Complex Activity Recognition with Missing Data	Swapnil Sayan Saha (University of California - Los Angeles)*; Sandeep Singh Sandha (University of California - Los Angeles); Mani Srivastava (University of California - Los Angeles)
					269	Cooking Activity Recognition with Convolutional LSTM using Multi-label Loss Function and Majority Vote	Atsuhiro Fujii (Ritsumeikan University); Daiki Kajiwara (Ritsumeikan University); Kazuya Murao (Ritsumeikan University)*
					270	Let's not make it complicated - Using only LightGBM and Naive Bayes for macro and micro activity recognition from a small dataset	Ryoichi Kojima (KDDI Research, Inc.)*; Roberto Legaspi (KDDI Research, Inc.); Kiyohito Yoshihara (KDDI Research, Inc.); Shinya Wada (KDDI Research, Inc.)
Question-Answer Session for Cooking Activity Challenge							
Result: Cooking Activity Challenge							

			Summary of the Cooking Activity Recognition Challenge	Sayedha Shamma Alia (Kyushu Institute of Technology)*, Paula Lago (Kyushu Institute of Technology), Shingo Takeda (Kyushu Institute of Technology), Kohei Adachi (Kyushu Institute of Technology), Brahim Benissa (Kyushu Institute of Technology), M.A.R. Ahad (University of Dhaka), and Sozo Inoue (Kyushu Institute of Technology)
1705	1730		Award & Closing Ceremony: Seiichi Serikawa , Vice-President, Kyushu Institute of Technology; Sozo Inoue , Kyushu Institute of Technology; Atsushi Inoue , Amazon Web Service; MAS Kamal , Gunma University	

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Maria Del Pilar Villamil Giraldo, University of Los Andes, Colombia

Mohiuddin Ahmad, Khulna University of Engineering & Technology, Bangladesh

Pascal Hirmer, University of Stuttgart, Germany

Paula Lago, Kyushu Institute of Technology, Japan

Philipp M. Scholl, University of Freiburg, Germany

Phond Phunchongharn, KMUTT, Thailand

Ren Ohmura, Toyohashi University of Technology, Japan

Ricky J Sethi, Fitchburg State University, USA

Shigeyuki Miyagi, The University of Shiga Prefecture, Japan

Shoji Kobashi, University of Hyogo, Japan

Stephan Sigg, Aalto University, Finland

Susanna Pirttikangas, University of Oulu, Finland

Trung Thanh NGO, Osaka University, Japan

Tsuyoshi Okita, Kyushu Institute of Technology / Riken, Japan

Upal Mahbub, University of Maryland, College Park, USA

Yu Enokibori, Nagoya University, Japan

Secretaries:

Tahera Hossain, Kyushu Institute of Technology, Japan

Moe Matsuki, Kyushu Institute of Technology, Japan

Nattaya Mairiththa, Kyushu Institute of Technology, Japan

Tittaya Mairiththa, Kyushu Institute of Technology, Japan

<https://abc-research.github.io>

Keynote Talk 1: AI and Psychology

Michihiko Minoh
Executive Director
RIKEN



Abstract:

Recent development of AI technology may make it possible to construct a robot which behaves as if it has mind from the view point of humans. This research will be interested in both basic science in which we consider what is mind and how the mind works and AI technology in which we will develop robot easier to be used. From this view point, RIKEN started a new project called temporarily "Psychology based AI Robotics". In this talk, I will give you a rough sketch of how psychology will be used in AI and Robotics.

Short Biography:

Michihiko Minoh is appointed as Executive Director, RIKEN in April 2018. He received the B.Eng., M.Eng. and D.Eng.degrees in Information Science from Kyoto University, in 1978, 1980 and 1983, respectively. He was Professor of Academic Center for Computing and Media Studies(ACCMS), Kyoto University from April 2002 to March 2018. He served as director of ACCMS from April 2006 to March 2010 and concurrently served as vice director in the Kyoto University President's Office from October 2008 to September 2010. From October 2010 to September 2016, he served as chief information officer at Kyoto University and director-general at Institute for Information Management and Communication, Kyoto University.

His research interest includes a variety area of Image Processing, Artificial Intelligence and Multimedia Applications, particularly, model centered frame work for the computer system to help visual communication among humans and information media structure for human communication.

Keynote Talk 2: Eye Movement Detection Sensors, Biometrics, and Health Assessment

Oleg Komogortsev

Professor

Texas State University



Abstract:

The usage of eye tracking sensors is expected to grow in virtual (VR) and augmented reality (AR) platforms. In my talk I will discuss the past and present status of eye tracking sensors, along with my vision for future development. I will also discuss applications that necessitate the presence of such sensors in VR/AR devices, along with applications that would have the power to benefit society on a large scale when VR/AR solutions are widely adopted.

Short Biography:

Dr. Komogortsev is currently a tenured Professor at Texas State University. Dr. Komogortsev has received his B.S. in Applied Mathematics from Volgograd State University, Russia, and M.S./Ph.D. degree in Computer Science from Kent State University, Ohio. He has previously worked for such institutions as Johns Hopkins University, Notre Dame University, and Michigan State University. Dr. Komogortsev conducts research in eye tracking with a focus on cyber security (biometrics), health assessment, human computer interaction, usability, and bioengineering. This work has thus far yielded more than 100 peer reviewed publications and several patents. Dr. Komogortsev's research was covered by the national media including NBC News, Discovery, Yahoo, Livesience and others. Dr. Komogortsev is a recipient of four Google awards including two Virtual Reality Research Awards (2016, 2017), Google Faculty Research Award (2014), and Google Global Faculty Research Award (2018). Dr. Komogortsev has also won National Science Foundation CAREER award and Presidential Early Career Award for Scientists and Engineers (PECASE) from President Barack Obama on the topic of cybersecurity with the emphasis on eye movement-driven biometrics and health assessment. In addition, his research is supported by the National Science Foundation, National Institute of Health, National Institute of Standards, Sigma Xi the Scientific Research Society, and various industrial sources. Dr. Komogortsev's current grand vision is to push forward eye tracking solutions in the future virtual and augmented reality platforms as enablers of more immersive experiences, security, and assessment of human state.

Keynote Talk 3: Security and Privacy Challenges in Learning-enabled IoT Systems

Mani Srivastava, Fellow, ACM; Fellow, IEEE
Professor
University of California, LA



Abstract:

Innovative edge devices, pervasive wireless connectivity, and powerful cloud computing are leading to a new generation of learning-enabled IoT systems. Unlike their precursors that primarily focused on collecting sensor data for off-line knowledge discovery and simple control, this new generation of IoT systems harness machine learning (ML) to make rich inferences about the state of natural, engineered, and human systems; to comprehend and project it to the future; and to decide on actions that influence and nudge that state in a desired and timely manner. While data-driven ML algorithms are helping equip these emerging IoT systems with intelligence and autonomy, they also introduce vulnerabilities to a variety of security and privacy problems. This talk will cover research in my group on (i) efficient black-box attacks on sensor data and machine learning models that cause these systems to make incorrect inferences and control actions, (ii) defense mechanisms that help detect and mitigate these attacks, and (iii) protecting against privacy loss arising from inference attacks on high-dimensional sensory data being shared by differentially-private synthetic sensor data generation.

Short Biography:

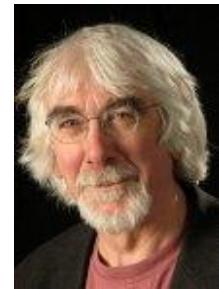
Mani Srivastava is on the faculty at UCLA where he is associated with the ECE Department with a joint appointment in the CS Department. His research is broadly in the area of networked human-cyber-physical systems, and spans problems across the entire spectrum of applications, architectures, algorithms, and technologies. His current interests include issues of energy efficiency, privacy and security, data quality, and variability in the context of systems and applications for mHealth and sustainable buildings. He is a Fellow of both the ACM and the IEEE. More information about his research is available at his lab's website: <http://www.nesl.ucla.edu> and his Google Scholar profile at <https://scholar.google.com/citations?user=X2Qs7XYAAAAJ>.

Keynote Talk 4: Virtual and Augmented Reality Animals in Smart and Playful Cities

Anton Nijholt

Professor-Emeritus

University of Twente



Abstract:

Our future urban environments are smart. Sensors and actuators are embedded in these environments and their inhabitants. We have an Internet of Things, where the 'Things' include objects, cars, tools, buildings, street furniture, and whatever can be equipped with sensors and actuators, including human and non-human animals. Augmented humans and augmented animals have their senses extended with digital technology. Their smart wearables connected with the smart environment make humans and animals smarter. Rather than on living animals, in this survey paper we focus on non-living virtual and augmented reality non-human animals that will inhabit our smart and playable urban environments. They will co-exist with robotic animals and (digitally augmented) humans and nonhuman animals. We include observations on augmented humans interacting with virtual and augmented reality animals. The paper is meant to raise awareness for the possibilities of augmented reality to introduce virtual animals for social, entertainment, and educational reasons.

Short Biography:

Anton Nijholt is Professor-Emeritus of the University of Twente. He started his professional life as a programmer at TNO-Delft, The Netherlands. He studied civil engineering, mathematics and computer science at the Delft University of Technology and did his Ph.D. in theoretical computer science at the Vrije Universiteit in Amsterdam. He held positions at the University of Twente, the University of Nijmegen, McMaster University (Canada), the Vrije Universiteit Brussels (Belgium), and at the Netherlands Institute for the Advanced Study of Humanities and Social Sciences NIAS) in Wassenaar. During some years he was a scientific advisor of Philips Research Europe, Eindhoven. A few years (2015-2017) he was a global research fellow at the Imagineering Institute in Iskandar, Johor, Malaysia. In 2018 he became a member of Microsoft's Technical Leadership Advisory Board on Brain-Computer Interfaces (BCI). Anton Nijholt has an interest in human-computer interaction, entertainment computing, affective computing, humor research, playable cities, and Brain-Computer interfacing. He has been program chair and general chair of the main international conferences and workshops devoted to these topics (ICMI, F&G, ACE, IVA, ACII). Nijholt is chief-editor of the specialty section Human-Media Interaction of the journals *Frontiers in Psychology* and *Frontiers in Computer Science*. He is also the series editor of the Springer Book Series on Gaming Media and Social Effects.

Abstracts of Oral Sessions (SINGLE-TRACK)

Day 1: 26 August 2020

1215~1330: IVPR-1: Generator

168: Synthesizing Cell Protein data for Human Protein Cell Profiling Using Dual Deep Generative Modeling

Rakesh Ranjan (*Kyushu Institute of Technology, Japan*), Tomohiro Shibata (*Kyushu Institute of Technology, Japan*), Sozo Inoue (*Kyushu Institute of Technology, Japan*)

To understand the biology of health, and how molecular dysfunction leads to disease, knowledge of the human cell is essential. The protein is the core unit of the human body made from trillions of cells, forming the body's various tissues. These tissues come together to create human organs. It is essential to understand the Spatio-temporal distribution of proteins in cells and to investigate human RNA-sequencing for human genes characterization. For this, it requires a massive amount of annotated data. However, due to many considerations like the high cost of data sample collection, lack of data sample availability, and lawful clauses for patient privacy, the majority of medical data is out of reach for general public research. In this study, we propose a new dual deep generative method for synthesizing human cell protein images by using the Generative Adversarial Network technique. Specifically, for that, we pair original cell protein images with their respective Cell-protein-tree. These pairs are then used to learn the mapping from a binary cell protein to a new cell protein image. For this purpose, we use an image-to-image translation technique based on adversarial learning. The generated cell protein images are expected to preserve the structural and visual quality of the training images. Visual and quantitative analysis of the experimental results demonstrates that the synthesized data are preserving the desired quality while maintaining the different forms of original data.

16: Early Pulmonary Embolism Detection from Computed Tomography Pulmonary Angiography Using Convolutional Neural Networks

Ching-Yuan Yu (*National Chiao-Tung University, Taiwan*), Chin Kuo (*National Cheng Kung University, Taiwan*), Yun-Chien Cheng (*National Chiao-Tung University, Taiwan*)

In this study, we developed the first computer-aided detection (CAD) system aimed at triage patients with pulmonary embolism (PE) to reduce the death rate during the waiting period. Computed tomography pulmonary angiography (CTPA) is used for definite diagnosis of PE, and CTPA imaging reports are read by radiologists who suggest further management, which requires time and hence a waiting period to obtain a diagnosis. Patients may die during this waiting period, and a CAD method can triage patients with PE from those without PE. In this study, we proposed a CAD system to achieve the aforementioned purpose. Our purpose is different from related studies and CAD systems that were aimed at identifying key PE lesion images in images of patients with PE to expedite PE diagnosis. Our CAD system consists of a novel classification-model ensemble for PE detection and a segmentation model to label PE lesion on each image. We utilized data from the National Cheng Kung University Hospital and open resource to construct models. In the classification model, the algorithm achieved an area under the receiver operating characteristic curve of 0.88 (accuracy = 0.85). In the segmentation model, the mean intersection over union was 0.689. Overall, our CAD system successfully distinguished patients with PE from those without PE and automatically labeled the PE lesion to expedite PE diagnosis.

26: AdversarialQR: An adversarial patch in QR code format

Aran Chindaodom (*Mahidol University, Thailand*), Prarinya Siritanawan (*Japan Advanced Institute of Science and Technology, Japan*), Karin Sumongkayothin (*Mahidol University, Thailand*), Kazunori Kotani (*Japan Advanced Institute of Science and Technology, Japan*)

In this paper, we present a method to camouflage an attack on image recognition system by using an adversarial patch embedded on a scan-ready QR code. Adversarial patch refers to a class of a real-world attack on a machine learning system that adds a 'patch' onto the image. However, unlike existing methods, they are highly conspicuous to human perception. As these attacks are performed in the real world, they require users to manipulate the scene. However, not only the patch catches the attention of the classification system but also bystanders' attention as well. We believe that forcing the adversarial patch into the form of a scan-ready QR code can conceal its primary reason to exist in the scene. The main challenge of the research is the process of forcing an adversarial patch into a scan-ready QR code while trying to retain as much information for the patch to work as a real-world adversarial example. The experiments had been done to investigate trade-off compared to training the patch in different shapes.

3: Deep Learning with AnoGAN and Efficient GAN to Judge Agricultural Harvest Image Data

Shinji KAWAKURA (Osaka City University, Japan), Ryosuke SHIBASAKI (The University of Tokyo, Japan)

Recent social and academic endeavors have required judging harvest images to determine whether they show edible produce. Thus, we construct, apply, analyze, and present deep-learning-based Anomaly Detection with Generative Adversarial Nets (AnoGAN) and Efficient Generative Adversarial Nets (Efficient GAN) including the system for implementation. Specifically, we first capture and accumulate two image datasets, one where the images were judged by experienced agri-workers as showing edible produce, and the other where the images were judged as showing inedible content. Then, we construct a system to generate corrected picture datasets using Keras based on the GAN (in this study, particularly AnoGAN and Efficient GAN). Furthermore, we apply a discriminator to judge the images in the dataset. Considering past studies, the discriminator has adequate accuracy for certain practical uses, however not for our purpose, so we apply AnoGAN and Efficient GAN to improve the results. Here, we present numerical data on effective detection and removal of inedible harvests. This system could provide benefits for agri-workers and developers, and, in future, realize more precise and stable agri-analyzing.

97: PerceptionGAN: Real-world Image Construction from Provided Text through Perceptual Understanding

Kanish Garg (Indian Institute of Technology Delhi, India), Ajeet Kumar Singh (Indian Institute of Technology Delhi, India), Dorien Herremans (Singapore University of Technology and Design, Singapore), Brejesh Lall (Indian Institute of Technology Delhi, India)

Generating an image from a provided descriptive text is quite a challenging task because of the difficulty in incorporating perceptual information (object shapes, colors, and their interactions) along with providing high relevancy related to the provided text. Current methods first generate an initial low-resolution image, which typically has irregular object shapes, colors, and interaction between objects. This initial image is then improved by conditioning on the text. However, these methods mainly address the problem of using text representation efficiently in the refinement of the initially generated image, while the success of this refinement process depends heavily on the quality of the initially generated image, as pointed out in the Dynamic Memory Generative Adversarial Network (DM-GAN) paper. Hence, we propose a method to provide good initialized images by incorporating perceptual understanding in the discriminator module. We improve the perceptual information at the first stage itself, which results in significant improvement in the final generated image. In this paper, we have applied our approach to the novel StackGAN architecture. We then show that the perceptual information included in the initial image is improved while modeling image distribution at multiple stages. Finally, we generated realistic multi-colored images conditioned by text. These images have good quality along with containing improved basic perceptual information. More importantly, the proposed method can be integrated into the pipeline of other state-of-the-art text-based-image-generation models such as DM-GAN and AttnGAN to generate initial low-resolution images. We also worked on improving the refinement process in StackGAN by augmenting the third stage of the generator-discriminator pair in the StackGAN architecture. Our experimental analysis

and comparison with the state-of-the-art on a large but sparse dataset MS COCO further validate the usefulness of our proposed approach.

1340~1510: IEV-1: Data Mining & Informatics

209: Anomaly Detection using Variational Autoencoder with Spectrum Analysis for Time Series Data

Umaporn Yakkampon (Kyushu Institute of Technology, Japan), Sakmongkon Chumkamon (Kyushu Institute of Technology, Japan), Abbe Mowshowitz (The City College of New York, USA), Shih-Chii Liu (University of Zurich and ETH Zurich, Switzerland), Eiji Hayashi (Kyushu Institute of Technology, Japan)

Uncertainty is an ever present challenge in life. To meet this challenge in data analysis, we propose a method for detecting anomalies in data. This method, based in part on Variational Autoencoder, identifies spiking raw data by means of spectrum analysis. Time series data are examined in the frequency domain to enhance detection of anomalies. In this paper, we validate the proposed method using standard datasets. Experimental results show that the comparison of the frequency domain with the original data can improve the validity and accuracy of anomaly detection. Therefore, analyzing time-series data using a combination of Variational Autoencoder and the frequency domain spectrum can be effective in detecting anomalies.

179: IntellCache: An Intelligent Web Caching Scheme for Multimedia Contents

Nishat Tasnim Niloy (University of Dhaka), Md. Shariful Islam (University of Dhaka)

The traditional reactive web caching system is getting less popular day by day due to its inefficiency in handling the overwhelming requests for multimedia content. An intelligent web caching system intends to take optimal cache decisions by predicting future popular contents (FPC) proactively. In recent years, a few approaches have proposed some intelligent caching system where they were concerned about proactive caching. Those works intensified the importance of FPC prediction using the prediction models. However, only FPC prediction may not help to get the optimal solution in every scenario. In this paper, a technique named IntellCache has been proposed that increases the caching efficiency by taking a cache decision i.e. content storing decision before storing the predicted FPC. Different deep learning models such as- multilayer perceptron (MLP), Long short-term memory (LSTM) of Recurrent Neural Network (RNN) and ConvLSTM a combination of LSTM and Convolutional Neural Network (CNN) are compared to identify the most efficient model for FPC. The information on the contents of 18 years from the MovieLens data repository has been mined to evaluate the proposed approach. Results show that this proposed scheme outperforms previous solutions by achieving a higher cache hit ratio and lower average delay and thus, ensures users' satisfaction.

255: Forecasting the Risk of Type II Diabetes using Reinforcement Learning

Most. Fatematz Zohora (Jahangirnagar University, Bangladesh), Marzia Hoque Tania (University of Oxford, UK), M Shamim Kaiser (Jahangirnagar University, Bangladesh), and Mufti Mahmud (Nottingham Trent University, UK)

Type II Diabetes (T2D) is one of the most common lifestyle diseases which is characterized by insulin resistance. Lack of insulin's proper working causes uncontrollable blood glucose rise in the body which leads to life taking situations. Therefore, early detection of T2D is imperative to save many lives. Towards this goal, this work presents a machine learning-based prediction model to detect T2D. The Q-learning algorithm belonging to the Reinforcement Learning (RL) paradigm has been applied to the PIMA Indian Women diabetes dataset in developing the detection model.

The model identifies patients with T2D using three factors (such as Body Mass Index, glucose level and age of subject) by generating an off-policy based RL and making the learning agent to find an optimal policy for the factors. The information of a subject can be in any of 330 possible states.

The proposed RL model's accuracy, Precision, Recall, F-measure and AUC values have been compared with the state-of-the-art techniques such as K Nearest Neighbors and Decision Tree. The performance of the proposed RL-based T2D prediction outperforms the K Nearest Neighbors and Decision Tree."

164: Hybrid Text Summarizer for Bangla Document

Mahimul Islam (Ahsanullah University of Science & Technology, Bangladesh), Fariha Nuzhat Majumdar (Ahsanullah University of Science & Technology, Bangladesh), Asadullahil Galib (Ahsanullah University of Science & Technology, Bangladesh), Md Moinul Hoque (Ahsanullah University of Science & Technology, Bangladesh)

Automatic text summarization is needed to concisely extract a small subset of text portion from a large text where the isolated text may have sentences which are more significant compared to other sentences in the text. Although there have been a lot of approaches on English text summarization, very few works have been done on automatic Bengali text summarization. For the evaluation purpose, a data set was formulated from the scratch with Bengali news documents from two reputed newspapers. The evaluation data set was classified in four different classes with benchmark standard summary text generated by a group of random people for each of the documents. The current work presents a hybrid approach for dealing with summarization process of Bengali text documents. The hybrid model is introduced with a goal to improve the overall accuracy of the summary text generation. The proposed model generates a summary text based on sentence scoring, sentiment analysis and interconnection of sentences. Empirical verification with other similar systems shows that, the proposed model can be used as an alternative system to address the Text Summarization problem of Bengali documents. After conducting the evaluation on existing data set, the proposed system performs with an average of 0.77 Recall Score, 0.57 Precision Score and 0.64 F-measure score.

239: Knowledge-Base Optimization to Reduce the Response Time of Bangla Chatbot

Md. Kowsher (Noakhali Science and Technology University, Bangladesh), Anik Tahabilde (Western Carolina University, USA), Md. Zahidul Islam Sanjid (BRAC University, Bangladesh), Nusrat Jahan Prottasha (Daffodil International University, Bangladesh), Md. Murad Hossain Sarker (Comilla University, Bangladesh)

Chatbots have been very popular in recent years for being able to serve as a customer representative, a language learner and so forth. Long short-term memory abbreviated as LSTM is a ubiquitous artificial recurrent neural network that is frequently being used for the chatbot. Nevertheless, if a user makes the line break of sequence, then it is rare to inform the right information without the impact of the previous sequence. As a result, in case of a help desk chatbot, LSTM is not the best option for taking steps of the right information. On the other hand, mathematical and statistical procedures are prominently useful for providing the proper knowledge without having back the impact of sequence. Still, it takes more execution time to respond. The goal of this paper is to present the optimal chatbot for the lowest execution time and three mathematical and statistical strategies for Bangla Intelligence chatbot in light of information obtained from Noakhali Science and Technology University (NSTU). As the procedures, we have followed cosine similarity, Jaccard similarity, and Naive Bayes classifier. To reduce the response time, we decorated the whole path into a 3-depth tree, such as a question, topic, and answer. We have compared the performance of the selected strategies where the best accuracy was 93.22% using the cosine similarity.

218: A learning mechanism for BRBES using enhanced Belief Rule-Based Adaptive Differential Evolution

Raihan Ul Islam (Luleå University of Technology, Sweden), Mohammad Shahadat Hossain (University of Chittagong, Bangladesh), Karl Andersson (Luleå University of Technology, Sweden)

Nowadays, belief rule-based expert systems (BRBESs) are widely used in various domains which provides a framework to handle qualitative and quantitative data by addressing several kinds of uncertainty. Learning plays an important role in BRBES to upgrade its knowledge base and parameters values, necessary for the improvement of the prediction accuracy. Different optimal training procedures such as

Particle Swarm Optimisation (PSO), Differential Evolution (DE), and Genetic Algorithm (GA) have been used as learning mechanisms. Among these procedures, DE performs comparatively better than others. However, DE's performance depends significantly in assigning near optimal values to its control parameters including cross over and mutation factors. Therefore, the objective of this article is to present a novel optimal training procedure by integrating DE with BRBES. This is named as enhanced belief rule-based adaptive differential evolution (eBRBaDE) algorithm because it has the ability to determine the near-optimal values of both the control parameters while ensuring the balanced exploitation and exploration in the search space. In addition, a new joint optimization learning mechanism by using eBRBaDE is presented where both parameter and structure of BRBES are considered. The reliability of the eBRBaDE has been compared with evolutionary optimization algorithms such as GA, PSO, BAT, DE and L-SHADE. This comparison has been carried out by taking account of both conjunctive and disjunctive BRBESs while predicting the Power Usage Effectiveness (PUE) of a datacentre. The comparison demonstrates that the eBRBaDE provides higher prediction accuracy of PUE than from other evolutionary optimization algorithms.

1610~1740: IVPR-2: 3D Vision

229: Towards Detailed 3D Modeling: Mesh Super-Resolution via Deformation

Ryo Tamura (Aoyama Gakuin University, Japan), Seiya Ito (Aoyama Gakuin University, Japan), Naoshi Kaneko (Aoyama Gakuin University, Japan), Kazuhiko Sumi (Aoyama Gakuin University, Japan)

This paper presents a method for constructing a detailed mesh model by deforming a coarse mesh model using surface normals estimated from images. Mesh representation is a 3D data structure that can represent a detailed shape with fewer parameters compared with other data structures. Multi-view stereo (MVS) algorithms are suitable for reconstructing a detailed mesh model from images captured from different viewpoints; however, the computation time increases rapidly as the resolution and the number of images increase. To overcome this problem, we propose a novel approach to deform a coarse mesh model. We first reconstruct a coarse mesh model by applying the Delaunay triangulation to a coarse point cloud obtained through structure-from-motion. The resulting model is deformed based on the changes in the surface normals estimated from images. In our experiments, we demonstrate that our method constructs detailed 3D models faster than the MVS with a single model dataset and general scene dataset.

21: Object Detection in 3D Point Clouds via Local Correlation-Aware Point Embedding

Chengzhi Wu (Karlsruhe Institute of Technology, Germany), Julius Pfrommer (Fraunhofer Center for Machine Learning, Fraunhofer IOSB, Germany), Jürgen Beyerer (Fraunhofer Center for Machine Learning, Fraunhofer IOSB, Germany), Kangning Li (Karlsruhe Institute of Technology, Germany), Boris Neubert (Karlsruhe Institute of Technology, Germany)

We present an improved approach for 3D object detection in point clouds data based on the Frustum PointNet (F-PointNet). Compared to the original F-PointNet, our newly proposed method considers the point neighborhood when computing point features. The newly introduced local neighborhood embedding operation mimics the convolutional operations in 2D neural networks. Thus features of each point are not only computed with the features of its own or of the whole point cloud, but also computed especially with respect to the features of its neighbors. Experiments show that our proposed method achieves better performance than the F-Pointnet baseline on 3D object detection tasks.

22: New Graph Embedding Approach for 3D Protein Shape Classification

Kamel Madi (Umanis, Research & Innovation, France), Eric Paquet (National Research Council Canada, Canada)

We address the problem of 3D protein deformable shape classification. Proteins are macromolecules characterized by deformable and complex shapes which are related to their function making their classification an important task. Their molecular surface is represented by graphs such as triangular

tessellations or meshes. In this paper, we propose a new graph embedding based approach for the classification of these 3D deformable objects. Our technique is based on graphs decomposition into a set of substructures, using triangle-stars, which are subsequently matched with the Hungarian algorithm. The proposed approach is based on an approximation of the Graph Edit Distance which is characterized by its robustness against both noise and distortion. Our algorithm defines a metric space using graph embedding techniques, where each object is represented by a set of selected 3D prototypes. We propose new approaches for prototypes selection and features reduction. The classification is performed with supervised machine learning techniques. The proposed method is evaluated against 3D protein benchmark repositories and state-of-the-art algorithms. Our experimental results consistently demonstrate the effectiveness of our approach.

185: Performance Evaluation of Markerless 3D Skeleton Pose Estimates with Pop Dance Motion Sequence

Rollyn T. Labuguen (Kyushu Institute of Technology, Japan), Wally Enrico M. Ingco (Ateneo de Manila University, Philippines), Salvador Blanco Negrete (Kyushu Institute of Technology, Japan), Tonan Kogami (Kyushu Institute of Technology, Japan), Tomohiro Shibata (Kyushu Institute of Technology, Japan)

The evaluation of markerless pose estimation performed by OpenPose has been getting much attention from researchers of human movement studies. This work aims to evaluate and compare the output joint positions estimated by the OpenPose with a marker-based motion-capture data recorded on a pop dance motion. Although the marker-based motion capture can accurately measure and record the human joint positions, this particular set-up is expensive. The framework to compare the outputs of the markerless method to the ground truth marker-based joint remains unknown, especially for complex body motion. Synchronization, camera calibration, and 3D reconstruction by fusing the outputs of the markerless method (OpenPose) are discussed. In this case study, the comparison results illustrate that the mean absolute errors for each key points are less than 700 mm.

211: Feature Bridging Networks for 3D Human Body Shape Estimation from a Single Depth Map

Naoshi Kaneko (Aoyama Gakuin University, Japan), Mei Oyama (Ricoh Company, Ltd., Japan), Masaki Hayashi (Keio University, Japan), Seiya Ito (Aoyama Gakuin University, Japan), Kazuhiko Sumi (Aoyama Gakuin University, Japan)

This paper describes a novel deep neural network architecture to reconstruct an accurate human body shape from a single depth map. The proposed method utilizes a statistical parametric body shape model, which represents a wide variety of body shape with low-dimensional body shape parameters. We formulate the body shape reconstruction as a regression problem of the body shape parameters. One of the biggest challenges of the single-image shape reconstruction lies in a gap between input and output modalities. This is because an input depth map only contains a surface of a human body, while the output is a full 3D body shape model. To bridge this gap, we utilize dedicated two deep neural networks ShapeEncoder and DepthMapEncoder, which respectively process the 3D body model and the depth map. These two networks are bridged with a learned latent body feature space to enable accurate single-image body shape estimation. Furthermore, the proposed method also uses body joint positions estimated from the depth map to further improve the performance. The proposed approach is evaluated on real depth maps taken from 30 subjects and achieves significant performance improvements over the existing methods.

220: Two-Stream 3D Convolution Attentional Network for Action Recognition

Raden Hadapiningsyah Kusumoseniarto (National Taiwan University of Science and Technology, Taiwan)

We propose a new method, which uses a two-stream 3D convolution network to capture rich spatial and temporal information, then process it with an attention module to capture long- and short-term dependency, to recognize action on the videos. By taking advantages of 3D convolutions, not only spatial information is obtained, but the movement information on the videos is also captured as temporal

information. The main reason to consider long-term temporal dependency information is that it will be important to identify action on the videos. The bidirectional self-attention network uses forward/backward masks to encode temporal order information, and attention to handle our sequence on 3D convolution features. The experimental results indicate that the proposed method can be compared to state-of-the-art work in the HMDB-51 dataset with a less complex process while maintaining the performance.

1750~1920: ABC-1: Activity & Behavior Analysis

88: A Basic study on Ballroom Dance Figure Classification with LSTM Using Multi-modal Sensor

Hitoshi Matsuyama (Nagoya University, Japan), Kei Hiroi (Kyoto University, Japan), Katsuhiko Kaji (Aichi Institute of Technology, Japan), Takuro Yonezawa (Nagoya University, Japan), Nobuo Kawaguchi (Nagoya University, Japan)

The paper presents a ballroom dance figure classification method with LSTM using video and wearable sensors. Ballroom dance is a popular sport among people regardless of age or sex. However, learning ballroom dance is very difficult for less experienced dancers as it has many complex types of "dance figures", which is a completed set of footsteps. Therefore, we aim to develop a system to assist dance exercise which gives advice proper to each dance figure characteristic by recognizing dance figures correctly. While the major approach to recognize dance performance is to utilize video, we cannot simply adopt it for ballroom dance because the images of dancers overlap each other. To solve the problem, we propose a hybrid figure recognition method combining video and wearable sensors to enhance its accuracy and robustness. We collect video and wearable sensor data of seven dancers including acceleration, angular velocity, and body parts location change by pose estimation. After that, we pre-process them and put them into an LSTM-based deep learning network. As a result, we confirmed that our approach achieved an F1-score of 0.86 for 13 figure types recognition using the multi-modal sensors with trial-based 5-fold cross-validation. We also performed user-based cross-validation, and sliding window algorithms. In addition, we compared the results with our previous method using Random Forest and also evaluated the robustness with occlusions. We found the LSTM-based method worked better than Random Forest with keypoint data. On the other hand, LSTM could not perform well with a sliding window algorithm. We consider the LSTM-based method would work better with a larger dance figure data, which is our next work. In addition, we will investigate how to solve occlusion problems with pose estimation.

181: Reducing Energy Consumption by Behavioural Change

Dietrich Albert (University of Graz & Graz University of Technology, Austria), Michael A. Bedek (University of Graz & Graz University of Technology, Austria), Wolfgang A. Horn (Horn Consult, Leibnitz, Austria)

On global as well as national levels, top-down approaches to reduce climate-related energy consumption have not been successful and effective at all until now. Thus, a bottom up approach is recommended: citizens role should change from consumers to prosumers, to (co-)decision-makers regarding energy-related behavior, and to co-investors in the new energy infrastrucure. However, behavioural change is difficult to realize in face of the 'knowledge-behaviour gap', 'value-action gap', or 'attitude-behaviour gap'. Thus, the CODALoop project collected data with its platform Energanz and developed the socio-cognitive model for energy-related behaviour. In the new planned IF4E project that model becomes an integrated module of a process model for energy-related behavioural change with real-time feedback loops, real-time energy consumption data, and a user's Personal Energy Profile (PEP) which is updated continuously. The challenges and risks in investigating and implementing the proposed process model in real settings for changing climate-related energy consumption behaviour are discussed. This position paper aims receiving feedback of experts regarding the planned project before its realization.

194: Estimation of Record Contents for Automatic Generation of Care Records

Haru Kaneko (Kyushu Institute of Technology, Japan), Tahera Hossain (Kyushu Institute of Technology, Bangladesh), Sozo Inoue (Kyushu Institute of Technology, Japan)

Elderly persons are increasing all over the world. Smart nursing facilities are required to support them for their good health. Especially in Japan, it is essential to have automated nursing facilities center to support the relentlessly increasing elderly person all over the country. As long as elderly people are increasing, the demand for nursing care services are also increasing day by day. There is a shortage of nurse to support this vast elderly people. In order to resolve the shortage of nurse, it is important to reduce the work load for nurse. There are some research to simplify the care recording process. The main approach is activity recognition or the development of new apps. However, we aimed for automatic generation of the care records of near future. So in this paper, we evaluate the accuracy of the automatic generation of care records using care record data from real nursing facility to simplify the task of making care records. We made two machine learning models to estimate the "target patient" and the "recorded value" of care records. And we evaluated the classification result from the data collected by the care record app. We used two months of data we collected from Japanese nursing facility for the evaluation. We can achieve, average F1-score of 'target patient' estimation is 74% and the average F1-score of 'detail of record' estimation is 58%. We believe that using these results in care records app will simplify the task of making care records.

74: Biological and Behavioral Information-based Method of Predicting Listener Emotions toward Speaker Utterances during Group Discussion

Motoki Sakai (Tokyo Denki University, Japan), Masaki Shuzo (Tokyo Denki University, Japan), Masahide Yuasa (Shonan Institute of Technology, Japan), Kanae Matsui (Tokyo Denki University, Japan), Eisaku Maeda (Tokyo Denki University, Japan)

There are many types of learning environments presented in higher education venues, requiring the development of a diverse repertoire of learning abilities. Group discussion (GD) is one such learning environment, and the students who participate require multiple communication skills. Technically, it is desirable for a student participating in a GD to understand other participants' emotional reactions toward their utterances to improve their locution, content, etc. The purpose of this research is to predict listeners' emotions in response to speakers' utterances using multimodal sensors. In experiments, GDs were conducted with 20 students. Six basic emotions were recorded as responses to speakers' utterances during the GDs using an emotional annotation tool. This study predicted the occurrence of the emotions by using an accelerometer, an electrocardiogram (ECG), and an electromyography (EMG). From sensor data, 56 features in the time and frequency domains were calculated, and Kruskal-Wallis tests and multiple comparison tests were performed to investigate whether there were significant differences among the features collected. As a result, there were significant differences among the groups of six basic emotions ($p < 0.01$). As an application, it has been shown that negative and positive emotions could be distinguished by support vector machine (SVM) with 76% F1.

126: Investigating Correlations Between Usage of Communication Apps and Instant Messenger and a Smartphone User's Extraversion

Anja Exler (Karlsruhe Institute of Technology (KIT), Germany), Tobias Hornberger (Karlsruhe Institute of Technology (KIT), Germany), Michael Beigl (Karlsruhe Institute of Technology (KIT), Germany)

Smartphones are widely used and an integral part of our everyday lives. They are a main means for communication with friends and family. Due to the manifoldness of instant messengers, it is possible to chat or talk to others easily, anytime and anywhere. However, smartphone users' differ among each others: while some prefer to talk to others and share their thoughts on social media, others prefer privacy and restrict interaction to a necessary minimum. We want investigate correlations between the user's extraversion personality trait and their use of communication apps and instant messenger. Within a user study with 23 participants over the course of up to 28 days, we collected data about call and SMS history as well as notification reception and app usage. Our results revealed statistically significant correlations between call duration - overall, but also for outgoing or incoming calls - and number of notifications per day and different levels of extraversion. Future research might include the analysis of rich media

notifications, notification content, social media activity, but also considering formality of a notification and type of interlocutor.

189: Multilabel Classification of Nursing Activities in a Realistic Scenario

Farina Faiz (Kyushu Institute of Technology, Japan), Yoshinori Ideno (CARECOM CO., LTD, Japan), Hiromichi Iwasaki (University of Fukui Hospital, Japan), Yoko Muroi (University of Fukui Hospital, Japan), Sozo Inoue (Kyushu Institute of Technology, Japan)

Nursing activities are complex in nature: in real scenario, when nurses perform care-giving activities, they can perform concurrent activities or multiple activities at a time. With traditional supervised learning it is very difficult to classify them especially when there is no proper information of sequence and duration of activities performed. In this paper, we used a new nursing dataset collected in complete natural setting. As our observer could not enter the room of patient to record the duration of each activity, we utilized multilabel classification in this scenario. We considered our work both as multiclass classification and multilabel classification. We applied 1) Random Forest for multiclass classification, 2) Binary Relevance and 3) Random Forest SRC (Survival, Regression and Classification) for multilabel classification. By evaluating the result, we found out that Random ForestSRC achieved highest performance that is around 86% precision, 62% recall and 63% F1 score whereas Random Forest achieved around 10% precision, 11% recall and 10% F1 score and Binary Relevance achieved around 28% precision, 13% recall and 17% F1 score. We also explained why multilabel classification is necessary to recognize activities in real scenario problems.

Day 2: 27 August 2020

1200~1330: IEV-2: Machine Learning

210: Visual Analytics for Anomaly Classification in LAN Based on Deep Convolutional Neural Network

Yuwei Sun (The University of Tokyo, Japan), Hiroshi Esaki (The University of Tokyo, Japan), Hideya Ochiai (The University of Tokyo, Japan)

Information systems accelerate the advancement of society. However, malicious manipulation of information would bring great harm. Recently, criminal groups are increasingly involved in cybercrime, especially in the Local Area Network (LAN). Several methods are being used to analyze network traffic in LAN such as extracting the transition patterns in traffic flows, however, research on visualization of network traffic, thus detecting and classifying various abnormal events, is insufficient. In this research, we propose visual analytics for generating feature maps of network events based on protocol information. We extract protocol information of ARP, TCP, and UDP from network traffic and generate each type of feature maps. Then for each event, we merge these three types into one image by putting them into different channels, to represent features. We simulate and visualize eight types of network events in LAN which are the normal, arp scan, tcp scan, scan of tcp port 23, scan of tcp port 80, udp scan, scan of udp port 137 and scan of udp port 1900. Then for this multiclass classification problem, we adopt a deep convolutional neural network (CNN) to differentiate between these network events, with these eight types as labels and generated feature maps as inputs. We evaluated the scheme using precision, recall, and F-measure in two LANs, at last, achieving an average F-measure of 0.76.

156: Mutual Information based Feature Selection for Nurse Care Activity Recognition

Md. Hasan Tarek (University of Dhaka, Bangladesh), Md. Eusha Kadir (University of Dhaka, Bangladesh), Mahir Mahbub (University of Dhaka, Bangladesh), Pritom Saha Akash (University of Dhaka, Bangladesh), Amin Ahsan Ali (Independent University, Bangladesh), Mohammad Shoyaib (University of Dhaka, Bangladesh)

Human activity recognition is a challenging task as performing the activities varies from person to person. For the last few years, many complex methods have been proposed to identify human activities from sensor readings. To date, several studies have been conducted successfully to identify simple activities and many commercial applications have also been developed. However, reliable recognition of complex activities is still an active research area. The nurse care activity dataset can be treated as a complex activity recognition dataset. Researchers have proposed many solutions to identify nurse care activity by extracting numerous handcrafted features or using the spatio-temporal graph convolution method. However, some of these features may be noisy, redundant, or even distract the classifier performance. In this paper, we propose a feature selection strategy to select important features from the handcrafted features. We claim that the simple classifier can provide satisfactory performance once the important features are selected and the noisy ones are eliminated. Experiments demonstrate that our proposed approach achieves 87.93% accuracy and 87.97% f1-score in test data. This is a significant improvement over state-of-the-art approaches on this benchmark dataset and thereby establishing our claim.

103: Pathfinder: A Fog Assisted Vision-Based System for Optimal Path Selection of Service Robots

Niloy Irtisam (University of Dhaka, Bangladesh), Riad Ahmed (University of Dhaka, Bangladesh), Mohammad Moniruzzaman Akash (University of Dhaka, Bangladesh), Raiyaan Abdulllah (University of Dhaka, Bangladesh), Sujan Sarker, Sejuti Rahman (University of Dhaka, Bangladesh), Lafifa Jamal (University of Dhaka, Bangladesh)

Service delivery application involving robots relies on the success of the navigation process. To ensure maximum performance, the navigation process should generate optimal path avoiding collisions with dynamic obstacles. Selecting such a path by analyzing the dynamic environment condition while putting minimal overhead on robots is a challenging problem in service robot navigation. In this work, we develop a Fog assisted service robot navigation system that puts most of the computing tasks to a central Fog server.

The server employs a vision-based monitoring system to locate the robots and obstacles. The optimal path is generated by analyzing the available information and the robots are instructed accordingly. We implement a test-bed system to evaluate the performance of the proposed system. The results depict that the proposed fog-based system can achieve as low as 23.81% of average distance covered, 22.05% of average service delivery time, and 22.72% of average energy consumption compared to the without fog systems.

54: An Improved Adaptive Optimization Technique for Image Classification

Nazmus Saqib (Khulna University o Engineering & Technology, Bangladesh), Fatema Tuz Zahra (Khulna University o Engineering & Technology, Bangladesh)

In deep learning, the optimization techniques are for the most part dependent on gradient descent methods, such as SGD, ADAM which adopt the leading place in the area of optimization methods. Fortuitous methodologies which depend on stochastic gradients are non-adaptive because the prescribed parameter worth's usage should be tuned for every application. But the generalization performance of the stochastic optimizers is far superior to the adaptive methods, whereas ADAM and its variants cannot maintain this without a fast convergence rate in deep neural networks. To improve this generalization performance, we need to diminish the oscillation of the weights which is the general problem of the accuracy fall. Thus, we have attempted to propose Mean- ADAM, a variance of ADAM which has extended the updated weights by an external weight to diminish the oscillation and overcome a superior accuracy rate than all other adaptive gradient methods till the conclusion of the training. Therefore, we can substantially improve the generalization performance, permitting it to contend with SGD with momentum on image classification datasets such as MNIST, CIFAR 10, CIFAR 100, ImageNet, etc. We have attained 82% at 150 epochs with CIFAR10 and 99.49% with MNIST whereas the ADAM has indicated 76% and 99.43% individually.

177: An Integrated Real-Time Deep Learning and Belief Rule Base Intelligent System to Assess Facial Expression Under Uncertainty

Tawsin Uddin Ahmed (University of Chittagong, Bangladesh), Mohammad Newaj Jamil (University of Chittagong, Bangladesh), Mohammad Shahadat Hossain (University of Chittagong, Bangladesh), Karl Andersson (Luleå University of Technology, Sweden), Mohammed Sazzad Hossain (University of Liberal Arts, Bangladesh)

Nowadays, the recognition of facial expression draws significant attention in various domains. In view of this, a real-time facial expression recognition system has been developed using a Deep Learning approach, which can classify ten emotions, including angry, disgust, fear, happy, mockery, neutral, sad, surprise, think, and wink. In addition, an integrated expert system has also been developed by integrating Deep Learning with a Belief Rule Base to support the assessment of the overall mental state of a person over a period of time from video streaming data under uncertainty. In this research, data-driven and knowledge-driven approaches are integrated together to assess the mental state of an individual. Such a system could enable the identification of a suspect before committing any crime beforehand by the law enforcement agency. The performance of this integrated system is found reliable than existing methods of facial expression assessment.

90: Alzheimer's Disease Prediction Using Convolutional Neural Network Models Leveraging Pre-existing Architecture and Transfer Learning

Mahjabeen Tamanna Abed (BRAC University, Bangladesh), Umme Fatema (BRAC University, Bangladesh), Shanewas Ahmed Nabil (BRAC University, Bangladesh), Md. Ashraful Alam (BRAC University, Bangladesh), Md Tanzim Reza (BRAC University, Bangladesh)

Early Alzheimer's Disease (AD) or Mild Cognitive Impairment (MCI) can be diagnosed through proper examination of several brain biomarkers. In recent times, several high-dimensional classification techniques have been suggested to discriminate between AD and MCI on the basis of T1-weighted MRI of patients. These techniques have been implemented mostly from scratch, making it really difficult to achieve any meaningful result within a short span of time. Therefore, the classification of AD is usually a very

daunting and time-consuming task. In our study, we trained high dimensional Deep Neural Network (DNN) models with transfer learning in order to achieve meaningful results very quickly in terms of detecting AD from fMRI image. The fMRI image dataset has been collected from Alzheimer's Disease Neuroimaging Initiative (ADNI). We have used three different DNN models for our study: VGG19, Inception v3, and ResNet50 to classify AD, MCI, and Cognitively Normal (CN) patients. Firstly, we implemented some pre-processing steps on the images and divided them into training, testing, and validation sets. Secondly, we initialized these DNN models with the weights from pre-existing models trained on the ImageNet dataset. Finally, we trained and evaluated all the DNN models. After a relatively short amount of training (15 epochs), we achieved an approximate of 90% accuracy with VGG19, 85% accuracy with Inception v3, and 70% with ResNet50. Thus, we achieved excellent classification accuracy in a very short time with our research.

1430~1600: IVPR-3: Algorithms

17: Multi-branch Semantic Segmentation Network

LiHua We (Inner Mongolia University, China) , YingDong Ma (Inner Mongolia University, China)

Effective semantic segmentation requires both spatial details and object-level semantic information. Meanwhile, context information is also important for complex scene understanding. However, it is hard to meet these demands simultaneously in the top-down CNN structure. In this paper, we tackle this problem with a Multi-branch Semantic Segmentation Network (MSS Net). The proposed MSS Net consists of three parts, including a spatial network, a semantic network and a context network. The spatial network utilizes convolutional layers with small stride and a spatial pyramid pooling module to extract multi-scale spatial features. In the semantic network, multiple level features are combined to enhance semantic information. The context network integrates different scales contextual information to facilitate objects localization in complex scene. The proposed semantic segmentation framework has been evaluated on the CamVid and the Cityscapes datasets. Experimental results demonstrate that the MSS Net achieves state-of-the-art performance.

18: Multi-Level Feature and Context Pyramid Network for Object Detection

Xia Wang (Inner Mongolia University, China), Yingdong Ma (Inner Mongolia University, China)

Robust object detection requires fine details to represent object structure and high-level semantic knowledge extracted from deep feature maps. Besides, contextual information is also important for exact location of multiple scale objects. However, it is difficult to meet these demands simultaneously in the top-down CNN structure. In this work, we present the Multi-Level Feature and Context Pyramid Network (MLFCP Net) to tackle this problem. The proposed MLFCP Net consist of two main modules. To utilize advantages of multiple level features, the Multi-level Feature Fusion (MFF) module combines different layer feature maps to form enhanced multi-level features. The Context Pooling Aggregation module combines local and global context features to further improve detection accuracy. Our method achieves 84.9% mAP on PASCAL VOC2007 test at 16.7FPS with 320×320 input and 42.5% AP on MS COCO. Experimental results demonstrate effectiveness of the proposed feature fusion method and the context aggregation scheme.

34: A Warp Speed Chain-Code Algorithm Based on Binary Decision Trees

Stefano Allegretti (Università degli Studi di Modena e Reggio, Italy), Federico Bolelli (Università degli Studi di Modena e Reggio, Italy), Costantino Grana (Università degli Studi di Modena e Reggio, Italy)

Contours extraction, also known as chain-code extraction, is one of the most common algorithms of binary image processing. Despite being the raster way the most cache friendly and, consequently, fast way to scan an image, most commonly used chain-code algorithms perform contours tracing, and therefore tend to be fairly inefficient. In this paper, we took a rarely used algorithm that extracts contours in raster scan, and

optimized its execution time through template functions, look-up tables and decision trees, in order to reduce code branches and the average number of load/store operations required. The result is a very fast solution that outspeeds the state-of-the-art contours extraction algorithm implemented in OpenCV, on a collection of real case datasets.

128: The Planar/Hyper-Planar Rotated Polar Coordinate System and Its Mathematical Solid Vector Addition, Multiplication, Division, Dot Product and Cross Product Operations

Jalal Al-Anssari (University of Cincinnati, United States), Inam Naser (University of Cincinnati, United States), Anca Ralescu (University of Cincinnati, United States)

In geometry, the curvilinear coordinate systems have curved coordinate lines. They are used to localize physical or virtual quantities in image processing computer science, space science, earth science, cartography, quantum mechanics, relativity, and other engineering sciences. Their Mathematical operations are useful for defining the motion of these quantities and objects under the influence of central forces, and solving equation of curved boundary conditions. The typical ones are the correct 2D Polar mathematical operations; and the wrong 3D Spherical mathematical operations. The problem statement is that there is no available definition of curvilinear one that is 3D and correct, except the Solid Vector Subtraction operation which was recently proposed and used to develop 3D spatial filters of field of vectors for geometrical edge detection in 3D image processing science. In this research, this Solid Vector Subtraction is extended by proposing its 3D and correct definitions of: (1) Rotated Polar coordinate system; (2) 2D, 3D, and hyper dimensional space; and (3) Other whole complementary set of Solid Vector Addition, Multiplication, Division, Dot Product, and Cross Product operations. Because their justification has a long derivation, it is for future work. These Solid Vector operations are 3D and correct.

222: Visual Attention: Deep Rare Features

Matei Mancas (University of Mons Information, Belgium), Phutphalla Kong (Institute of Technology of Cambodia, Cambodia), Bernard Gosselin (University of Mons Information, Belgium)

Human visual system is modeled in engineering field providing feature-engineered methods which detect contrasted/surprising/unusual data into images. This data is “interesting” for humans and leads to numerous applications. Deep learning (DNNs) drastically improved the algorithms efficiency on the main benchmark datasets. However, DNN-based models are counter-intuitive: surprising or unusual data is by definition difficult to learn because of its low occurrence probability. In reality, DNNs models mainly learn top-down features such as faces, text, people, or animals which usually attract human attention, but they have low efficiency in extracting surprising or unusual data in the images. In this paper, we propose a model called DeepRare2019 (DR) which uses the power of DNNs feature extraction and the genericity of feature-engineered algorithms. DR 1) does not need any training, 2) it takes less than a second per image on CPU only and 3) our tests on three very different eye-tracking datasets show that DR is generic and is always in the top-3 models on all datasets and metrics while no other model exhibits such a regularity and genericity. DeepRare2019 code can be found at <https://github.com/numediart/VisualAttention-RareFamily>.

224: Second-Order Estimation Based Attention Network for Metric Learning

Zeyu Sun (Waseda University, Japan), Sei-ichiro Kamata (Waseda University, Japan)

Mapping image data into the embedding space where objects of the same class or label have a short distance between each other and objects belonging to different classes have long margins in between, is an essential task for many computer vision applications. However, current approaches struggle to map image data into a proper embedding space due to the difficulty of finding discriminative features from a large number of features of the original dataset. Existing approaches include finding effective loss and new sampling methods, which do not consider improving the embedding space by selecting fine features extracted by the network. In this work, we proposed a new attention approach by exploiting the variance of features and improve the performance of the current metric learning method. Our proposed approach

consists of a variance estimation module(VEM) and fusion stage for applying channel-wise attention on extracted features. It is easy to implement and fast for training. Unlike other traditional second-order based methods, the variance estimation module does not embed second-order calculation in the network itself, and cost no large extra computation time in the evaluation stage. The experiment shows high performance compared with current state-of-art methods on multiple metric learning benchmark datasets such as CUB200-2011, CARS196, In-shop Clothes.

1750~1920: ABC-2: Activity Analysis: Devices & Systems

187: Exploring Human Activities Using eSense Earable Device

Md Shafiqul Islam (Kyushu Institute of Technology, Japan), Tahera Hossain (Kyushu Institute of Technology, Japan), Md Atiqur Rahman Ahad (Osaka University, Japan), Sozo Inoue (Kyushu Institute of Technology, Japan)

Detecting head- and mouth-related human activities of elderly people are very important for nurse care centers. They need to track different types of activities of elderly people like swallowing, eating, etc. to measure the health status of elderly people. In this regard, earable devices open up interesting possibilities for monitoring personal-scale behavioral activities. Here, we introduce activity recognition based on an earable device called 'eSense'. It has multiple sensors that can be used for human activity recognition. 'eSense' has a 6-axis inertial measurement unit with a microphone and Bluetooth. In this paper, we propose an activity recognition framework using eSense device. We collect accelerometer and gyroscope sensor data from eSense device to detect head- and mouth-related activities along with other normal human activities. We evaluated the classification performance of the classifier using both accelerometer and gyroscope data. For this work, we develop a smartphone application for data collection from the eSense. Several statistical features are exploited to recognize head- and mouth related activities (e.g., head nodding, headshaking, eating and speaking), and regular activities (e.g., stay, walk and speaking while walking). We explored different types of machine learning approaches like Convolutional Neural Network (CNN), Random Forest (RnF), K-Nearest Neighbor (KNN), Linear Discriminant Analysis (LDA), Support Vector Machine (SVM), etc. for classifying activities. We have achieved satisfactory results. Our results show that using both accelerometer and gyroscope sensors can improve performance. We achieve accuracy of 80.45% by LDA, 93.34% by SVM, 91.92% by RnF, 91.64% by KNN, and 93.76% by CNN while we exploit both accelerometer and gyroscope sensor data together. The results demonstrate the prospect of eSense device for detecting human activities in various healthcare monitoring system.

150: Head-AR: Human Activity Recognition with Head Mounted IMU Using Weighted Ensemble Learning

Hristijan Gjoreski (Ss. Cyril and Methodius University, N. Macedonia), Ivana Kiprianovska (Jozef Stefan Institute & Jozef Stefan Postgraduate School, Slovenia), Simon Stankoski (Jozef Stefan Institute & Jozef Stefan Postgraduate School, Slovenia), Stefan Kalabakov (Jozef Stefan Institute & Jozef Stefan Postgraduate School, Slovenia), John Broulidakis (Emteq Ltd, United Kingdom), Charles Nduka (Emteq Ltd, United Kingdom), Martin Gjoreski (Jozef Stefan Institute & Jozef Stefan Postgraduate School, Slovenia)

This paper describes the machine learning (ML) method Head-AR, which achieved the highest performance in a competition with 11 other algorithms and won the Emteq Activity Recognition challenge. The goal of the challenge was to recognize eight activities of daily life from a device mounted on the head, which provided data from a 3-axis IMU: accelerometer, gyroscope, and magnetometer. The challenge dataset was collected by four subjects, one of which was used as a test for the challenge evaluation. The method processes the stream of sensors data and recognizes one of the eight activities every two seconds. The method is based on weighted ensemble learning, that combines three models: (i) a dynamic time warping classification model, which analyzes raw accelerometer data; (ii) a classification model that uses expert features; (iii) and a classification model that uses features selected by a feature selection algorithm.

To compute the final output, the predictions of the three models are combined using a novel weighing scheme. The method achieved an F1 score of 61.25% on the competition's evaluation.

39: Initial contact and toe-off event detection method for in-shoe motion sensor

Chenhui Huang (Biometrics Research Labs., NEC Corporation), Kenichiro Fukushi (Biometrics Research Labs., NEC Corporation), Zhenwei Wang (Biometrics Research Labs., NEC Corporation), Hiroshi Kajinati (Biometrics Research Labs., NEC Corporation), Fumiayuki Nihey (Biometrics Research Labs., NEC Corporation), Kentaro Nakahara (Biometrics Research Labs., NEC Corporation)

Initial contact (IC) and toe-off (TO) events are tools for measuring and analyzing human gait. As a simpler method for detecting gait events that depends only on inertial measurement unit (IMU) signals is needed, in this study, we propose a simpler signal feature-based method for detecting gait events that is feasible for use in-shoe motion sensor (IMS) systems, and these exact features are used to determine the timing of IC and TO according to biomechanical knowledge. We then evaluate the precision of the method. Twenty-six healthy subjects were recruited to participate in experiments, during which an IMS along with a Vicon 3-D motion analyzer were applied to measure the trajectory of the foot and to judge the IC and TO timing. Temporal features of the foot to ground kinematic waveform at the time of IC and TO are newly discovered by synchronizing the two systems. The temporal precision of an algorithm for automatic IC and TO detection is evaluated on the basis of root mean square error (RMSE) and intraclass correlation coefficient (ICC). The RMSE of the TO detection was 1.22%, and that of the IC was 1.40%. The ICC of the TO detection was 0.7011, and that of the IC was 0.7721. The results demonstrate the high detection accuracy and reliability of this simpler IC and TO automatic detection algorithm for IMSs.

149: Classification Method of Eating Behavior by Dietary Sound Collected in Natural Meal Environment

Haruka Kamachi (Aoyama Gakuin University, Japan), Takumi Kondo (Aoyama Gakuin University, Japan), Anna Yokokubo (Aoyama Gakuin University, Japan), Guillaume Lopez (Aoyama Gakuin University, Japan)

Having a conversation during a meal, eating slowly, and thorough chewing, are some of the passive weight-loss strategies. Furthermore, detecting eating behaviors such as the number of chewing and the duration of the conversation leads to positive dietary behavior. This paper proposes a method that can accurately quantify eating behavior in a natural meal environment. We used a bone conduction microphone and recorded the dietary sounds of 16 subjects. We manually labeled five eating behaviors, namely chewing, swallowing food, swallowing drink, speaking, and other sounds like noise. We then extracted 75 features from the collected dataset and applied appropriate machine learning algorithms and categorized the eating behaviors. The resulting models of discriminating between chewing and speaking was possible with high F1 score. However, they achieved a lower accuracy in classifying swallowing and other sounds, especially swallowing food and swallowing drink. Furthermore, the machine learning models confused swallowing food and swallowing drink as chewing. Therefore, it is necessary to find features that express better the differences between these three behaviors.

139: Markerless 3D Human Pose Tracking in the Wild with fusion of Multiple Depth Cameras: Comparative Experimental Study with Kinect 2 and 3.

Jessica Colombel (Université de Lorraine, France), David Daney (Inria Bordeaux Sud Ouest - IMS (UMR 5218), France), Vincent Bonnet (Univ. Paris Est Creteil, France), François Charpillet (Université de Lorraine, France)

Human-robot interaction requires a robust estimate of human motion in real-time. This work presents a fusion algorithm for joint center positions tracking from multiple depth cameras to improve human motion analysis accuracy. The main contribution is the proposed algorithm based on body tracking measurements fusion with an extended Kalman filter and anthropomorphic constraints, independent of sensors. As an illustration of the use of this algorithm, this paper presents the direct comparison of joint center positions estimated with a reference stereophotogrammetric system and the ones estimated with the new Kinect 3

(Azure Kinect) sensor and its older version the Kinect 2 (Kinect for Windows). The experiment was made in two parts, one for each model of Kinect, by comparing raw and merging body tracking data of two sided Kinect with the proposed algorithm.

The proposed approach improves body tracker data for Kinect 3 which has not the same characteristics as Kinect 2. This study shows also the importance of defining good heuristics to merge data depending on how the body tracking works. Thus, with proper heuristics, the joint center position estimates are improved by at least 14.6%. Finally, we propose an additional comparison between Kinect 2 and Kinect 3 exhibiting the pros and cons of the two sensors.

155: ExerSense: Real-Time Physical Exercise Segmentation, Classification, and Counting Algorithm Using an IMU Sensor

Shun Ishii (Aoyama Gakuin University, Japan), Kizito Nkurikiyeyezu (Aoyama Gakuin University, Japan), Mika Luimura (Turku University of Applied Sciences, Finland), Anna Yokokubo (Aoyama Gakuin University, Japan), Guillaume Lopez (Aoyama Gakuin University, Japan)

Even though it is well known that physical exercises have numerous emotional and physical health benefits, maintaining a regular exercise routine is quite challenging. Fortunately, there exist technologies that promote physical activity. Nonetheless, almost all of these technologies only target a narrow set of physical exercises (e.g., either running or physical workouts but not both) and are only applicable either in indoor or in outdoor environments, but do not work well in both environments. This paper introduces a real-time segmentation and classification algorithm that recognizes physical exercises and that works well in both indoor and outdoor environments. The proposed algorithm achieves a 95% classification accuracy for five indoor and outdoor exercises, including segmentation error. This accuracy is similar or better than previous works that handled only indoor workouts and those use a vision-based approach. Moreover, while comparable machine learning-based approaches need a lot of training data, the proposed correlation-based method needs only one sample of motion data of each target exercises.

1920~2020: Work-in-progress (WIP)-1

144: Glioma Histopathological Images Classification with Deep CNN and Object Level Features

Daisuke Saito (Mie University, Japan), Hiroharu Kawanaka (Mie University, Japan), Shinji Tsuruoka (Mie University, Japan), Bruce J. Aronow (Cincinnati Children's Hospital Medical Center, USA; University of Cincinnati, USA), V. B. Surya Prasath (Cincinnati Children's Hospital Medical Center, USA)

In the field of histopathology, there are enormous amount of imaging samples available for analysis. Evaluating the various disease stages of brain tumors are an important task in oncology and requires the pathologist to analyze manually. However, the computational image processing techniques can help alleviate this burden and can also provide results quantitatively. Recently, the availability of large scale histopathology datasets coupled with advances in machine learning models provide robust tools for identifying disease stage classification in brain glioma automatically. Despite the improved results obtained with recent state-of-the-art deep convolutional neural network (CNN) classification models, how the models learned and the explainability is an important requirement in a trusted devising computer aided diagnosis (CAD) system. In this work, we discuss the classification reasoning within the context brain glioma histopathological disease stages. Moreover, we identify relationships between the decisions made by an adapted CNN classification model and object level features extracted using cell nuclei regions that are advocated in traditional computational pathology area. We further test an approach based on the regions of interest extracted by CNN along with object level features with support vector machine (SVM) to check the significance of each object level feature in the disease stages classification by our improved CNN model. Our experimental results indicate that our deep CNN model correctly classifies low versus high grade gliomas and with very low error rates on the cancer genome atlas histopathological images.

216: The Measurement of bio medical reaction of the VR motion sickness in elderly subjects

Yutaka Yoshida (Nagoya City University, Japan), Emi Yuda (Tohoku University, Japan), Norihiro Ueda (Nagoya City University, Japan), Junichiro Hayano (Nagoya City University, Japan), Itaru Kaneko (Nagoya City University, Japan)

We evaluated effects on the biomedical reactions relating to VR motion sickness using VR (virtual reality) scene of amusement ride for the elderly subjects. By applying psychomotor vigilance test (PVT) before and after use of VR material, score of PVT were improved after the use of VR. By this result, elderly subjects may have weaker VR motion sickness. And concentration might be improved by activation of sympathetic nerve.

260: On the Elliptical Ring-canal of Starfish Routing

Md. Ahsan Habib (University of Dhaka, Bangladesh), Sajeeb Saha (Jagannath University, Bangladesh), Md. Abdur Razzaque (University of Dhaka, Bangladesh), Md. Mamun-Or-Rashid (University of Dhaka, Bangladesh)

Forming routing backbones in sensor networks are advantageous to minimize end-to-end latency and to maximize data throughput for real-time data collection. In the literature, Starfish routing backbone consists of a central ring-canal and few radial-canals that guarantees single hop access to one of the backbone nodes from any source node. The network performances and lifetime extension greatly depend on the optimal size of the ring-canal in the network. However, existing Starfish routing backbone develops circular ring-canal irrespective of square-shaped or rectangle-shaped network area. Therefore, in this paper, we propose an optimal ellipse as the central ring-canal on the Starfish routing backbone. The major-radius and minor-radius of the optimal ellipse are determined based on sensor's transmission range and network area. Later, we conduct simulation experiments to evaluate end-to-end latency and network lifetime and compare with state-of-the-art-works. The results show as high as 20% reduction on end-to-end latency and as high as 10% improvement on network lifetime for real-time data collection in sensor networks.

217: Relation between frequency of opening and closing of vascular and area of skin by microvascular

Yutaka Yoshida (Nagoya City University, Japan), Emi Yuda (Tohoku University, Japan), Yutaka Miura (Shigakkan University, Japan), Norihiro Ueda (Nagoya City University, Japan), Junichiro Hayano (Nagoya City University, Japan), Itaru Kaneko (Nagoya City University, Japan)

This report will describe relation between frequency of opening and closing of vascular and area of skin by microvascular wave. We name it Microvascular wave (MVW) and it is automatic movement of blood vessel and considered to be driven by calcium wave of smooth muscle cells those consist blood vessel wall. The observation of such spatial and temporal waveform of the blood vessel through the skin by regular camera had not been evaluated since now. Our overall goal is to confirm the possibility of such measurement. In the experiment, we recorded red spots which is a snare of capillaries. Temporal change of those spots is flickering with period between several ten seconds and one minutes. We assume those flickering is caused by the opening and closing of blood vessels by MVW and measured temporal changes by recording visual image of skin. Relation between frequencies and size of area will be analyzed and reported.

166: Development of Electrical Impedance Imaging System for Continuous Monitoring of Lung Diseases

Aniqa Tabassum (University of Dhaka, Bangladesh), Md. Adnan Kiber (University of Dhaka, Bangladesh)

This paper presents a new protocol and measurement technique of Electrical Impedance Imaging for continuous monitoring of lung diseases. In this proposed system, there are eight voltage measurement electrodes placed on the patient's back, along the outline of each lung, and two constant current injection electrodes, one posterior and one anterior. Traditional EIT based lung imaging methods used electrodes placed at a cross-sectional level on the chest with current injection and voltage measurement done in a cyclic order. Compared to such systems, the proposed model is found to be more sensitive and requires a

new design of Hardware and Interface, including Constant Current Injector, Potential Measurement Unit, a microcontroller-based Switching System, and a data acquisition system. The system has less complexity and computational burden. The proposed system was tested on a Phantom Model resembling the human thorax, according to International Standards. Data was collected using a saline solution of conductivity 1.52 S/m, resembling average lung fluid conductivity. Robustness of the proposed approach in disease detection was investigated by testing the phantom with anomalies. The system can detect the presence of such anomalies representing diseased lung tissues. However, it needs further development and testing in clinical settings.

253: Development of an optimal signal control method for the next-generation traffic at intersections

Makoto Hasegawa (Gunma University, Japan), M.A.S. Kamal (Gunma University, Japan), Kotaro Hashikura (Gunma University, Japan), Kou Yamada (Gunma University, Japan)

The next-generation traffic environment, which will contain automated vehicles and cloud-based infrastructures linked with individual vehicles using a high-speed communication network, is expected to provide real-time information to a traffic management system. This paper addresses such a next-generation traffic network and proposes an adaptive traffic signal control scheme at the intersection. The objective of the scheme is to reduce the waiting time of vehicles at the intersection by controlling the traffic signal timings. Particularly, the scheme in a model predictive control framework uses the information of all approaching vehicles and generates the optimal traffic signal for the intersection that minimizes the total traffic delay. For this purpose, a novel traffic flow model is developed that estimates the intersection crossing time of a vehicle for any given signal pattern. The model is found to be very accurate in predicting the vehicle's waiting time and facilitates in obtaining very fast optimization results. The optimal cycle and signal duration are used to control the traffic using a traffic simulator, and the performance of the proposed scheme is evaluated by observing 10 speed, density, idling time, and fuel consumption of all vehicles around the intersection. The results are compared with the existing traffic signal system.

136: Development of Cytology Support System using Machine Learning Methods

Hiroki Kiyose (University of Hyogo, Japan), Masakazu Morimoto (University of Hyogo, Japan)

In order to develop a cytology support system, we first apply U-net to separate the cytoplasm region, nucleus region, and background. After that, we extract 28 features from cell regions and the cancer level was predicted by regression analysis. As a result, we could predict cancer on Mean Squared Error (MSE) 0.0390 and Area Under the Curve (AUC) 0.987 with high accuracy for urothelial cells without nucleus contact.

271: Hand detection in UKA surgery videos using Deep Convolutional Neural Network

Shadman Sakib (University of Hyogo, Japan), Belayat Hossain (University of Hyogo, Japan), Takafumi Hiranaka (Takatsuki General Hospital, Japan), Syoji Kobashi (University of Hyogo, Japan)

Through the advancement of surgical procedures, Unicompartmental Knee Arthroplasty (UKA) has contributed to significant clinical results over the last decade. Detection of hand is one of the significant and crucial tasks in Orthopedic Surgery (OS) especially for the purpose of tool handling. While a variety of vision-based approaches were used for the recognition of hand gestures in the field of computer vision, proper detection of the hand in OS is still a difficult challenge in the surgical working environment. This is solely due to the different camera angles, frequent camera movement from the surgeon, high light exposure, inhomogeneous illumination, etc. Therefore, for the proper detection of hand with the presence of tools from UKA surgical video images, we proposed a Deep Convolutional Neural Network (DCNN) model. The primary objective of this paper is to classify hand, nohand, and nonsurgery regions from five UKA surgery videos. The model is trained using Resnet-50 for recognition accuracy. Results demonstrate that the model achieved a classification accuracy of 96%. Moreover, the performance of the model was also evaluated based on precision, recall, and f1-score for each class.

Day 3: 28 August 2020

1200~1330: IEV-3: Information System

169: Static Output Feedback Control Design for Takagi-Sugeno Descriptor Fuzzy Systems

Jun Yoneyama (Aoyama Gakuin University, Japan)

An output feedback control design is an important problem for practical systems because some of the state variables may not be measured and hence, a controller with state feedback is not feasible. Here, we are concerned with a new control design method via non-quadratic static output feedback control for fuzzy descriptor systems. Practical systems that are often modeled as a nonlinear system can be expressed by fuzzy descriptor systems. Such systems can describe nonlinear systems with equality constraints. For them, a control design method of admissible non-quadratic static output feedback controllers based on new design conditions is proposed. These conditions result from multiple Lyapunov matrix method and are relatively relaxed, and consequently they can be applied to a broader class of fuzzy descriptor systems. Admissibility conditions and admissible control design conditions are derived via Linear Matrix Inequalities (LMIs) with some given scalar and matrices. At the end, a simple simulation is provided to clarify our method.

106: Simulation of Pattern Formation of Swarm with Minimum Shape Parameters

Md. Tahmeed Abdullah (University of Dhaka, Bangladesh), Md. Jubair Ahmed Sourov (University of Dhaka, Bangladesh), Sejuti Rahman (University of Dhaka, Bangladesh) and Sujan Sarker (University of Dhaka, Bangladesh)

The topic of initializing and controlling the formation of robots in a multi-agent system has become a core research problem in swarm robotics as formation control is very useful for cooperative tasks. In this paper, we propose a hybrid method for the formation control of non-holonomic mobile robots by fusing behavior based swarm controllers with virtual structure approach. The proposed method is ideal for applications like search and rescue operations. The method is tested and evaluated through some simulation experiments which perform well for random shapes as well as polygonal shapes and convex hulls and it was observed that the time required to converge to the desired shape is independent of the shape complexity. The method utilizes only a few pieces of information to form shapes. The method also provides an easy technique to design new pattern shapes. The results show that the proposed method improves in formation controlling mechanism, applicability and variation of shapes.

99: Attack Detection in Internet of Things using Software Defined Network and Fuzzy Neural Network

Fahiba Farhin (Jahangirnagar University, Bangladesh), Ishrat Sultana (Jahangirnagar University, Bangladesh), Nahida Islam (Jahangirnagar University, Bangladesh), M Shamim Kaiser (Jahangirnagar University, Bangladesh), Md. Sazzadur Rahman (Jahangirnagar University, Bangladesh), Mufti Mahmud (Nottingham Trent University, UK)

Internet of Things (IoT) is a dynamic and distributed wide network system that can integrate a gigantic number of pervasive sensors (i.e., physical objects), wireless nodes, and ubiquitous computing systems. These sensors can collect tons of raw data, send them to the internet at an unprecedented rate, and convert them to actionable insights using computing systems. These sensing nodes or physical objects are vulnerable and have upraised cybersecurity threats. In this work, we proposed the attack detection model for IoT using Software-defined network (SDN). The SDN controller can analyze the traffic flow, detect the anomaly, and block incoming traffic as well as the source nodes. In the SDN, a fuzzy neural network (FNN) based attack detection system is considered which can detect attacks such as man-in-the-middle, distributed denial of service, side-channel, and malicious code. The FNN is trained and tested using NSL-KDD datasets. The evaluated performance exhibits that the FNN based attack detection system can detect the mentioned attack with an accuracy of 83%.

85: Water Quality Classification Using Data Mining Techniques: A Case Study on Wang River in Thailand

Kittichai Nortep (Thammasat University, Thailand), Krittakom Srijiranon (Thammasat University, Thailand), Narissara Eiamkanitchat (Chiang Mai University, Thailand)

In order to survive, the creatures need water, food, air, and residency. However, there are many water crises that influence water quality or cause water shortages. Rivers, which are important freshwater sources for human consumption, are often waste caused by their activities. This research utilizes data mining techniques to create classification models for water quality issues. The results are used in the application to alert the public about water quality problems that are aimed at changing their behavior. The data set consists of nine input features to identify dissolved oxygen in the next quarter, divided into two levels: "good" and "bad". The process of data preparation using various methods applies to the raw data before creating the classification model. This research proposes neural networks with a multilayer perceptron and k-nearest neighbor as a classifier called MLP-kNN. The results show that the proposed model is more effective when compared to various MLP algorithms. The classification rate is more than 0.95 while the F-score of both two classes is more than 0.9. Finally, the proposed model is implemented on the web application to report and prepare for water utilization planning.

243: Lemmatization Algorithm Development for Bangla Natural Language Processing

Md. Kowsher (Noakhali Science and Technology University, Bangladesh), Anik Tahabilder (Western Carolina University, USA), Md. Murad Hossain Sarker (Comilla University, Bangladesh), Md. Zahidul Islam Sanjid (BRAC University, Bangladesh), Nusrat Jahan Prottasha (Daffodil International University, Bangladesh)

Natural language processing (NLP) finds enormous applications in autonomous communication, while lemmatization is an essential preprocessing technique for simplification of a word to its origin-word in NLP. However, there is scarcity of effective algorithms in Bangla NLP. This leads us to develop a useful Bangla language lemmatization tool. Usually, some rule base stemming processes play the vital role of lemmatization in Bangla language processing as there is lack of Bangla lemmatization tool. In this paper, we propose a Bangla lemmatization framework using three effective lemmatization techniques based on data structures and dynamic programming. We have used Trie algorithm and developed a mapping algorithm named "Dictionary Based Search by Removing Affix (DBSRA)" based on data structure. We have applied both Trie and DBSRA lemmatization and selected the better one by considering the Levenshtein distance between the lemma and the original word. Eventually, we have experimented with Bangla language lemmatization among all three techniques and the framework. Among the three proposed techniques, the DBSRA performed better compared to others with an accuracy of 93.1 percent. The framework, developed by fusing three algorithms, came out with the highest efficiency of 95.89 percent.

41: Inference and Multi-level Learning in a Belief Rule-Based Expert System to Predict Flooding

Raihan Ul Islam (Luleå University of Technology, Sweden), Mohammad Shahadat Hossain (University of Chittagong, Bangladesh), Karl Andersson (Luleå University of Technology, Sweden)

Floods are one of the most dangerous catastrophic events. By the year 2050 flooding due to rise of ocean level may cost one trillion USD to coastal cities. Since flooding involves multi-dimensional elements, its accurate prediction is difficult. In addition, the elements cannot be measured with 100% accuracy. Belief rule-based expert systems (BRBESs) can be considered as an appropriate approach to handle this type of problem because they are capable of addressing uncertainty. However, BRBESs need to be equipped with the capacity to handle multi-level learning and inference to improve its accuracy of flood prediction. Therefore, this paper proposes a new learning and inference mechanism, named joint optimization using belief rule-based adaptive differential evolution (BRBaDE) for multi-level BRBES, which has the capability to handle multi-level learning and inference. Various machine learning methods, including Artificial Neural Networks (ANN), Support Vector Machine (SVM), Linear Regression and Long Short Term Memory have been compared with BRBaDE. The result exhibits that our proposed learning mechanism performs better than learning techniques as mentioned above in terms of accuracy in flood prediction.

1430~1600: IVPR-4: Vision and Imaging: Applications

140: Analysis of Tourists' Nationality Effects on Behavior-based Emotion and Satisfaction Estimation

Yuki Matsuda (Nara Institute of Science and Technology, Japan), Dmitrii Fedotov (Ulm University, Germany), Yutaka Arakawa (Kyushu University, Japan), Hirohiko Suwa (Nara Institute of Science and Technology, Japan), Wolfgang Minker (Ulm University, Germany), Keiichi Yasumoto (Nara Institute of Science and Technology, Japan)

Smart tourism is attracting attention of researchers in recent years. Its technologies can be used by tourists in order to obtain useful information during sightseeing with smart devices etc. To provide suitable and personalized tourism information according to the situation of tourists, understanding psychological status during sightseeing, especially, emotional status and satisfaction level, is important. We assume that the psychological status of tourists is appearing and represented through unconscious behaviors during sightseeing such as head/body movements and facial/vocal expressions, and have proposed methods to estimate emotion and satisfaction statuses by sensing and analyzing tourists' behaviors. Through in-the-wild experiments with 22 participants, we found that the difference in tourists' attributes might give effects for the estimation. In this paper, we have statistically analyzed those effects, focusing on tourists' nationality. As a result of the two-way ANOVA, we found the interaction effect (disordinal interaction) between tourists' nationality and estimation performance, the main effect in differences of features, and the main effect in differences of tourists' nationality. The results imply that we need to take tourists' nationality into account for building estimation models.

157: Embedded Discriminant Analysis based Speech Activity Detection for Unsupervised Stress Speech Clustering

Barlian Henryranu Prasetyo (University of Miyazaki, Japan), Hiroki Tamura (University of Miyazaki, Japan), Koichi Tanno (University of Miyazaki, Japan)

Speech activity detection (SAD) or sometimes called voice activity detection (VAD), is a crucial part of most speech-related applications. The SAD system serves to ensure the primary system processes only speech segments. Many speech-based systems have reported that detection accuracy is thanks to the robustness of their SAD system. Various SAD methods have been explored and enhanced in addressing noisy environments, but a few of them notice the emotional condition of the speakers. Whereas, in real conditions, emotions (such as stress) can pose a considerable impact on SAD system performance. In this paper, we propose a compact SAD system that is able to harmonize with the altered speech characteristics due to the presence of emotion and also powerful in high noise conditions. Since there is a similarity between emotional effect and channel effect, the advantages of the proposed SAD system is the applied of a new channel compensation scheme (termed as embedded discriminant analysis, EDA) that works in the i-vector space. We design the EDA in such a way so that it could compensate the presence of emotional condition. EDA transforms original i-vector to a lower-dimensional denoise embedding space. We develop EDA as simple and efficient as the linear discriminant analysis (LDA). The cosine similarity algorithm is applied to calculate the resemblance score between the audio target and the speech/non-speech models, and also for deciding the decision threshold. The effectiveness of the proposed SAD system is evaluated in the clustering task of Speech Under Simulated and Actual Stress (SUSAS) data, that aimed for the stress speech clustering (SSC) system.

240: Lip Reading using Facial Expression Features

Tatsuya Shirakata (Kyushu Institute of Technology, Japan), Takeshi Saitoh (Kyushu Institute of Technology, Japan)

Lip-reading technology that estimates speech content only from visual data without using audio data is expected as a next-generation interface. It can be used even in a situation where audio recognition is difficult such as in a high noise environment or a person with a speech disorder. The conventional methods use only features around the lips. This paper proposes a method to integrate facial expression features;

Expression-based feature and action unit-based feature into the lip-reading method. Evaluation experiments are conducted with three public databases of OuluVS, CUAVE, and CENSREC-1-AV. As a result, it is confirmed that the recognition accuracy is improved by integrating the facial expression feature for all databases.

13: Improved visual inspection for nozzle inner radius based on panoramic imaging

Sanao Huang (University of Science and Technology Beijing, China), Ke Xu (University of Science and Technology Beijing, China), Ruixin Wang (University of Science and Technology Beijing, China), Maocheng Hong(CGN Inspection Technology Co., Ltd., China)

Visual inspections of Nuclear Power Plant (NPP) reactors are important for understanding the current condition of the reactor components, such as nozzle inner radius. After addressing current deficiencies of the existing visual inspection methods, a panoramic image mosaicking method is proposed in this study to improve the efficiency and reliability of detection. However, unlike traditional mosaicking methods, the proposed method obtains the variation of the pixels between frames in a video by establishing a geometric mapping relationship between scenes and images. Then, the pixels which are varied between frames will be extracted and the frames will be combined to generate the mosaicked images. A function to discriminate overexposed pixels is also derived based on the redundant pixels in a series of frames, to reduce the impact of specular reflection on the resulting images. These above methods are applied to the detection of defects on nozzle inner radius of the mock-up. The resulting 360° panoramic images provide a large-field-of-view defect analysis approach to obtaining geometric measurements with pixel-level precision, and the image optimization method is found to mitigate the effects of specular reflection on defect identification by providing clear and reliable images. The results of this study demonstrate the promise of this new visual inspection method for NPP reactors, and establishes a potential foundation for the automatic detection of surface defects.

32: Diabetic retinopathy grading based on Lesion correlation graph

Daming LUO (Waseda University, Japan), Sei-ichiro KAMATA (Waseda University, Japan)

Diabetic Retinopathy (DR) is a leading cause of blindness. It often happens to people who suffer from diabetic and seldom has early warning signs. Automatically DR detection and severity grading are helpful for clinicians by providing a second opinion. An automatic classification system classifies fundus images into 5 degrees of severity. In this paper, we propose a DR grading model based on lesion correlation graph using Graph Convolution Network (GCN) and Convolution Neural Network (CNN). We extract the irregular lesion region by calculating SURF descriptors in the fundus image. We then cluster descriptors into a number of cluster centroids which is regarded as node representation. With the assistance of GCN, we learn lesion correlation. After fusing correlation information and fundus image feature, which is derived from CNN model, we obtain the final classification result. Furthermore, we provide two evaluation measures: accuracy and Cohen's Kappa value for comparison on different experiments. So far, our model achieves good result in several DR datasets.

225: Data Augmentation for Ancient Characters via Semi-MixFontGan

Yuan Zhiyi (Waseda University, Japan), Kamata Sei-ichiro (Waseda University, Japan)

The ancient documents provide people a way to understand history. However, the existing materials are suffering from unbalanced characters dataset, as well as intra-class multimodality fonts. As a result, humans and recognition systems are unable to identify these characters effectively. Based on these problems, we propose Semi-MixFontGan: a font generation method based on Semi-Supervised strategy that can learn from a small number of labeled font data to aggregate subclasses' information of categories and generate characters. In generating new samples from ancient books that have a small amount of labeled font data, the model can automatically learn the difference between them and generate font-consistent characters. The model is composed of two parts. In the first part, we propose a MixFont method to mix labeled and unlabeled and generated data. Then use a convolutional autoencoder to learn the font

information. In the second part, the generator network can generate reasonable and realistic images by Font and Content Discriminator. Through this model, we can make the ancient book dataset more balanced. Experiments show that the generated characters by our model can get good visual effects and maintain font consistency with training data. With the augmented data, the accuracy of the recognition network has increased.

1610~1740: IVPR-5: Medical Aspects

37: A Method for Predicting Dose Distribution of Nasopharyngeal Carcinoma Cases by Multiple Deep Neural Networks

Bilel Daoud (Kyushu University, Japan), Ken'ichi Morooka (Okayama University, Japan), Shoko Miyauchi (Kyushu University, Japan), Ryo Kurazume (Kyushu University, Japan), Wafa Mnejja (Radiotherapy Department of Habib Bourguiba Hospital Sfax, Tunisia), Leila Farhat (Radiotherapy Department of Habib Bourguiba Hospital Sfax, Tunisia) and Jamel Daoud (Radiotherapy Department of Habib Bourguiba Hospital Sfax, Tunisia)

In this paper, we propose a method for predicting dose distribution images of patients with Nasopharyngeal carcinoma (NPC) from contoured computer tomography (CT) images. The proposed system is based on our previous method. The first phase is to obtain the feature maps of 2D dose images of each beam from contoured CT images of a patient by convolutional deep neural network model. In the second phase, dose distribution images are predicted from the obtained feature maps by the integration network. Our modified system predicted dose distribution images accurately. From the experimental results using 80 NPC patients' images, the average number of pixels that satisfy the dose constraints of tumors and OARs regions is 81.9% and 86.1%, respectively. The proposed system had a global 3D gamma passing rates varying from 82.1% to 97.2% for all regions and an overall mean absolute errors (MAEs) was 1.0 ± 1.2 . From the obtained results, our modified system is superior to the results obtained in our previous system results and conventional methods.

223: A Review of the Technology of Activity Recognition for Dementia

Muhammad Fikry (Kyushu Institute of Technology, Japan), Defry Hamdhana (Kyushu Institute of Technology, Japan), Paula Lago (Kyushu Institute of Technology, Japan), Sozo Inoue (Kyushu Institute of Technology, Japan)

Technology can help and provide support to people with dementia stay safe in their daily activity. In this paper, we summarize information about activity recognition for dementia sufferers. The purpose of this paper is to understand the uses and type of applications, the kind of sensors/systems, methods, and data used within the scope of human activity recognition to monitor, detect symptoms or help with dementia. As a result, 447 abstracts were collected from a scopus database, yielding 127 relevant papers, and 102 papers that were considered in detail based on 4 categories of assessment (application, system/sensors, methods, data). This paper shows the trend of smart environment technology is most widely used for monitoring dementia sufferers with the classification of machine learning techniques as a method in activity recognition to get the results of testing or implementing the system. This review concludes that the combining of sensor devices and the addition of smartphone devices in one system is good for implementation because it can be used as an identity so that it distinguishes the object under study with other objects. During the monitoring process simultaneously prevention can be done by adding a warning alarm in the smartphone when people with dementia perform abnormal activities, and the results need to be further analyzed to get the best pattern of activities for people with dementia. After that, the type of application that was originally in the form of monitoring can develop into an assistant in people with dementia. Because they are really need a system that can be his assistant for helping to make decisions in their daily lives.

221: A Coarse to Fine Framework for Multi-organ Segmentation in Head and Neck Images

Yan Pu (Waseda University, Japan), Sei-ichiro Kamata (Waseda University, Japan), Youjie Wang (Waseda University, Japan)

Radiotherapy is widely used in the treatment of head and neck cancer. Due to the harmfulness of radiation, it is necessary to protect our healthy organs during the radiotherapy. Therefore, the accurate delineation of diseased region and surrounding healthy organs is the precondition for doctors to make the radiation plan. In real life, the delineation work is usually done manually. It is time-consuming and requires high professional skill. A fast and accurate organ segmentation method can greatly improve the efficiency of treatment. Most CT image datasets are 3D volumes and each volume can be divided into a series of 2D slice images. For multi-organ segmentation task, how to generate the stable organ features from CT images is still the plagued problem. For 2D framework, which processes the images slice by slice, the network cannot learn the correlation between continuous slices. It will lead to the loss of spatial information. For 3D framework, which processes the images volume by volume, the patch training is commonly used to against the massive increase of network parameters. The 3D patch will limit the maximum reception field of the network. For the organ, which is larger than the patch size, it is easy to lose global information. To solve these incompatible problems, we proposed a coarse to fine framework to take advantage of both 2D framework and 3D framework. The multi-view coarse network is designed to generate the organ probability maps and the coarse segmentation mask in 2D case. The organ volumes are extracted with the probability maps. These organ volumes are sent to the organ-based fine network to refine the mask of each organ in 3D case. Our proposed method is tested on the Head and Neck Automatic Segmentation Challenge datasets in 2015 and predict for 9 different organs. The result show that our framework performs the lowest error range for most organs and three of them achieve the top evaluation results in comparison with existing methods.

226: Combined Convolutional Neural Network for Highly Compressed Images Denoising

Binying LIU (Waseda University, Japan), Sei-ichiro KAMATA (Waseda University, Japan)

Many methods for denoising additive white Gaussian images have been developed, such as the use of non-local mean filters (NLF) and deep convolutional neural networks (CNN). However, these denoising methods still have many limitations on compressed images such as JPEG2000 compression. Based on quantization of noisy wavelet coefficients, JPEG2000 may lead to very specific visual artifacts. This compressed image's noise distribution model is highly spatially correlated and very different from the noise distribution model in additive Gaussian white noise images. In this paper, we propose a convolutional neural network structure combined with nonlocal filter. At first we train a convolutional neural network using highly compressed noisy images to obtain a specific noise model estimation and use this noise model estimation for the residual neural network. Secondly, it based on non-proximity average filtering, where a similar block selection method is modified to find block artifacts in the compressed image and then do denoising. Finally, combining these two methods can get a clear image output. The evaluation results of this method on the grayscale image dataset are better than the latest technology.

244: A Hybrid Deep Learning Framework using CNN and GRU-based RNN for Recognition of Pairwise Similar Activities

Md. Sadman Siraj (University of Dhaka, Bangladesh), Md. Atiqur Rahman Ahad (University of Dhaka, Bangladesh)

A challenging task in human activity recognition is to classify very naturally similar activities. In this paper, we introduce a unified deep learning model working as a hybrid framework of Convolutional Neural Network (CNN) and Gated Recurrent Unit (GRU) modules to solve the problem of recognizing activities that are similar and which occur in pairs in their distributions. We have trained and tested our model on two datasets comprising of pairwise similar activities. The proposed framework has been successful as it outperformed most of the state-of-the-art models for this task. This hybrid model achieves activity recognition accuracies of 89.14% and 87.76% on the two datasets respectively and proves itself accurate and scalable.

214: Stain-Refinement and Boundary-Enhancement Weight Maps for Multi-organ Nuclei Segmentation
Ruochan Wang (Waseda University, Japan), Sei-ichiro Kamata (Waseda University, Japan)

With the development of deep learning, high precision automatic segmentation of multi-organ nuclei pathological images is possible. The segmentation results require not only accurate foreground prediction but also careful annotation of every individual object. There are still several remaining challenges in multi-organ nuclei segmentation. Firstly, blurred boundaries and inconsistent staining make pixel-wise segmentation difficult to generate occlusive object masks. Secondly, the background noise will be retained or even enhanced after preprocessing. Thirdly, the differences in size, shape, and intensity of different organs make it harder to separate touching nuclei. Two novel weight maps of loss function are proposed, which make full use of structural information provided by raw image and its corresponding annotations, in order to supervise the network learning more available features. The Stain Refinement Weight Map focuses on the structural difference between Hematoxylin channel and Eosin channel, which has been neglected in existing methods, to highlight potential noise pixels. The Boundary-Enhancement Weight Map leverages the new boundary annotation of each individual object that has emerged in the recent dataset to help the network better divide cell clusters. We test our method on Multi-Organ Nuclei Segmentation Dataset and show that our proposed method has high accuracy in nuclei detection and can separate touching nuclei effectively in the segmentation task.

1750~1920: ABC-3: Activtiy & Behavior Analysis: Method

159: Accuracy Evaluation of Human Gait Estimation by a Sparse Set of Inertial Measurement Units
Tsubasa Maruyama (National Institute of Advanced Industrial Science and Technology, Japan), Haruki Toda (National Institute of Advanced Industrial Science and Technology, Japan), Suguru Kanoga (National Institute of Advanced Industrial Science and Technology, Japan), Mitsunori Tada (National Institute of Advanced Industrial Science and Technology, Japan), Yui Endo (National Institute of Advanced Industrial Science and Technology, Japan)

Inertial measurement units (IMUs) have been utilized as motion-capture (MoCap) devices in computer graphics, biomechanics, and rehabilitation. Typically, full-body motions are estimated from the orientation and/or acceleration data of 13 to 17 IMUs attached to the body segments of experimental subjects. However, attaching numerous IMUs is quite intrusive and sometimes restricts the subjects' motions. Recent advances in machine learning technologies have enabled full body motion estimation from a sparse set of IMUs (6 to 7 units). The present study compares the motion estimation accuracies of a system with a full set of IMUs (called full IMU MoCap) and a system with a sparse set of IMUs (called sparse IMU MoCap). Three male subjects performed three walking trials with different stride lengths (normal, short, and long), and their full body motions were estimated by each MoCap. Finally, the gait-related factors were calculated from each set of motion estimation results, and compared with the ground-truth data obtained by an optical marker-based MoCap. Although the sparse IMU MoCap achieved a lower overall accuracy than the full IMU MoCap, it can potentially evaluate the relative changes in the functionality of the locomotor during walking.

191: Improving Smartphone based Transport Mode Recognition using Generative Adversarial Networks
Lukas Günthermann (University of Sussex, United Kingdom), Andrew Philippides (University of Sussex, Brighton, United Kingdom), Daniel Roggen (University of Sussex, United Kingdom)

Wearable devices such as smartphones and smartwatches are widely used and record a significant amount of data. Labelling this data for human activity recognition is a time-consuming task, therefore methods allowing to reduce the amount of labelled data required to train accurate classifiers are important. Generative Adversarial Networks (GAN) can be used to model the implicit distribution of a dataset. Traditional GANs, which only consist of a generator and a discriminator, result in networks able to

generate synthetic data and distinguish real from fake samples. This adversarial game can be extended to include a classifier, which allows the training of the classification network to be enhanced with synthetic and unlabelled data. The network's architecture presented in this paper is inspired by SenseGAN, but instead of generating and classifying sensor-recorded time series data, our approach is working with extracted features, which drastically reduces the amount of stored and processed data and enables deployment on less powerful and potentially wearable devices. We show that this technique can be used to improve the classification performance of a classifier trained to recognise locomotion modes based on recorded acceleration data to reduce the amount of labelled training data necessary to achieve a similar performance. Compared to a baseline classifier, our approach reached the same accuracy up to 50% faster and was able to achieve a 10% higher accuracy in the same number of epochs.

190: New Class Candidate Generation applied to On-Body Smartphone Localization

Mitsuaki Saito (Tokyo University of Agriculture and Technology, Japan) and Kaori Fujinami (Tokyo University of Agriculture and Technology, Japan)

On-body device position-awareness plays an important role relative to providing smartphone-based services with high levels of usability and quality. Existing on-body device localization methods deal with a fixed number of positions. In contrast, we have proposed a framework to discover new positions that are not initially supported by the system and add them as recognition targets during use. In this paper, we focus on the task of detecting new class candidates in the framework, which consists of anomaly detection, dimension reduction, and clustering. Anomaly detection and dimension reduction are pre-processing to make clustering more effective. A preliminary experiment is carried out to prove the concept and find out that it is appropriate to implement the k-means clustering on the number of clusters estimated by X-means after performing anomaly detection by IForest and dimension reduction by t-distributed stochastic neighbor embedding (t-SNE).

183: Mapping Vicon Motion Tracking to 6-axis IMU Data for Wearable Activity Recognition

Lloyd Pellatt (University of Sussex, United Kingdom), Alex Dewar (University of Sussex, United Kingdom), Andrew Phillipides (University of Sussex, United Kingdom), Daniel Roggen, (University of Sussex, United Kingdom)

There are several large datasets available captured from motion tracking systems which could be useful to train wearable human activity recognition (HAR) systems, if only their spatial data could be mapped into the equivalent inertial measurement unit (IMU) data that would be sensed on body. In this paper we describe a mapping from 3D Vicon motion tracking data to data collected from a BlueSense on-body IMU. We characterise the error incurred in order to discern the extent to which it is possible to generate useful training data for a wearable activity recognition system from data collected with a motion capture system. We analyze this by mapping Vicon motion tracking data to rotational velocity and linear acceleration at the head, and compare this to actual gyroscope and accelerometer data collected by an IMU mounted on the head. In a 15 minute dataset comprising three static activities - sitting, standing and lying down, we find that 95% of the reconstructed gyroscope data is within an error of [-7.25;+7.46] deg · s⁻¹, while 95% of the reconstructed accelerometer data was contained within [-96.1;+72.9] m · G. However, when we introduce more movement by including data collected while walking this increases to [-19.0;+18.2] deg · s⁻¹ for the gyroscope and [-208;+186] m · G for the accelerometer. We conclude that generating accurate IMU data from motion capture datasets is possible and could be useful in providing larger volumes of data for activity recognition tasks and in helping enable advanced, data-hungry techniques such as deep learning to be employed on a larger scale within the domain of human activity recognition.

188: Improvement of Human Action Recognition Using 3D Pose Estimation

Kohei Adachi (Kyushu Institute of Technology, Japan), Paula Lago (Kyushu Institute of Technology, Japan), Tsuyoshi Okita (Kyushu Institute of Technology, Japan), Sozo Inoue (Kyushu Institute of Technology, Japan)

While human action recognition (HAR) using motion capture can perform well with high accuracy, it requires a high computational cost for recording and post-processing. To avoid this, we build a HAR

system using 3D pose estimation from single-camera video instead of motion capture. One drawback in this approach is that the performance is considerably dependent on the camera position. This paper investigates how we can use the pose estimate constantly without the effect of camera position even when the camera position in the test data is changed. We augment the data by rotating around the 3D pose estimate to improve the accuracy when using different camera positions in the test data and in the training data. The strategy of augmenting training data shows improvements up to 55.7% in accuracy, compared with the case of 2D pose with no augmentation.

165: 3D Pose Estimation Using Multiple Asynchronous Cameras

Takashi Morimoto (Hiroshima City University, Japan), Ikuhisa Mitsugami (Hiroshima City University, Japan)

This paper proposes a method for estimating the 3D pose of a person using multiple asynchronous cameras. In the proposed method, a 2D pose of a person is estimated from each captured image using OpenPose. To solve the asynchrony problem, we virtually generate the synchronous pose data by interpolating the temporally neighboring poses that are from actually captured images. Then, the 3D pose is reconstructed by triangulation from the virtually synchronized 2D poses from multiple cameras. In the experiment, the effectiveness of the proposed method was confirmed by capturing a moving person using eight cameras. We also investigated the effect of frame rate changes on pose estimation accuracy.

1920~2020: ABC-3: Work-in-progress (WIP)-2

107: Towards Automatic Waistline Measurement with A Smartwatch

Yuki Matsuda (Nara Institute of Science and Technology, Japan), Yugo Nakamura (Nara Institute of Science and Technology, Japan)

To solve obesity which is one of the causes of lifestyle-related diseases, people first need to know the state of their bodies such as waistline. We have considered that a belt, which people wear every day, can be used for waistline measurement without a burden. Hence, we study a method of automatic waistline measurement in people's daily life using a belt and sensing technologies. In this paper, we propose an acoustic-based automatic waistline measurement method using a common fashion belt and a widespread smartwatch's microphone. Through the preliminary experiments, we discuss the feasibility and technical issues of the proposed method.

145: Drone Control for Monitoring a Walking Person from Constant Distance

Hiroto Yamashita (Hiroshima City University, Japan), Takashi Morimoto (Hiroshima City University, Japan), Ikuhisa Mitsugami (Hiroshima City University, Japan)

We propose a drone system that automatically follows a walking person keeping capturing him/her from a certain distance. In this system, the person is detected from images captured by the drone camera using OpenPose, the position and orientation of the drone are controlled so as to make his/her size in the images constant. We experimentally controlled the drone to follow a person constantly from behind him and confirmed it runs with reasonable response time and positional stability.

182: Towards Mapping Activity Classes for Transfer Learning in Human Activity Recognition

Md Shafiqul Islam (Kyushu Institute of Technology, Japan), Sayeda Shamma Alia (Kyushu Institute of Technology, Japan), Sozo Inoue (Kyushu Institute of Technology, Japan)

In human activity recognition, collecting a large amount of data from sensors is a time-consuming and error-prone task. If there exists mislabeling that is action and labels are different then the performance of machine learning degrades. To handle this mislabeling issue, we propose two methods, sub-classing, and merging. In the sub-classing method, we make several sub-classes from an activity class. We then map new data records to newly created sub-class. In the merging method, we merge two activity classes and rename

it with a new label. Then we map test data records of similar activity to newly merged activity. We integrate these approaches into the transfer learning model. The transfer learning model transfers knowledge from source to target dataset. If the target dataset has a small amount of data then we can train our transfer learning model on the source dataset and then transfer knowledge to the target dataset. Combining subclassing or merging techniques with transfer learning will help to reduce the problems regarding mislabeling and a small amount of data.

238: Hardware Trojan for OFDM based Wireless Cryptographic ICs

Farshad (Bangladesh University of Engineering and Technology, Bangladesh), Md. Liakot Ali (Bangladesh University of Engineering and Technology, Bangladesh)

Hardware Trojan (HT) is now a burning issue in electronic circuit manufacturing supply chain. Over the last decade extensive research have been carried on HT detection methods for digital circuit. However the HT issue remains largely unexplored in the domain of Analog Mixed Signal (AMS)/ RF circuit where it is now an appealing target for the attackers. Now a days Orthogonal Frequency Division Multiplexing (OFDM) based wireless Cryptographic mixed signal ICs are widely used to exchange data securely over public channels. In this paper, we present a trigger based AMS HT threat model which exploits the Extended Cyclic Prefix (ECP) property of OFDM communication scheme to steal and leak the secret encryption key of 128 bit Advanced Encryption Standard (AES) encryption scheme over Additive White Gaussian Noise (AWGN) transmission channel. The possible detection mechanism for detecting such Trojan is also explored in this paper.

59: Data Driven Analysis of the Behaviour of Elderly People Using k-Means and Home Automation and Power Consumption Sensors

Bjorn Friedrich (Carl von Ossietzky University of Oldenburg, Germany), Enno-Edzard Steen (Carl von Ossietzky University of Oldenburg, Germany), Hirohiko Suwa (Nara Institute of Science and Technology, Japan), Andreas Hein (Carl von Ossietzky University of Oldenburg, Germany), Keiichi Yasumoto (Nara Institute of Science and Technology, Japan)

Information about the mental and physical conditions of elderly people are essential to assess their ability to live alone in their own homes. Usually, those information are collected using questionnaires and geriatrics assessments. However, both methods have their limitations. People might not answer honestly to personal questions and geriatrics assessments are only measuring the capacity at a specific point in time. Moreover, questionnaires and assessments are limited in catching variability. Elderly people which have similar scores in questionnaires and assessment can still be very different in terms of mental and physical conditions. To get a distinguished impression of the condition long-term monitoring is needed. In this article we show that the behaviour of elderly people is so distinguished, that they can be identified by using k-Means clustering on a dataset comprised of motion sensor data and power consumption sensor data. Moreover, we show that the results of a combined dataset is different to considering each participant separately. We applied the algorithm to three participants of a real-world study. Even though two of the participants have similar questionnaire and assessment scores, they can be clearly distinguished from each other as well as from the third participant who has different scores.

186: Towards New Performance Metrics for Multi-level Data for Activity Recognition

Sayedha Shamma Alia (Kyushu Institute of Technology, Japan), Paula Lago (Kyushu Institute of Technology, Japan), Sozo Inoue (Kyushu Institute of Technology, Japan)

Although activity recognition datasets are usually labeled with only one activity per timestamp, semantic annotations could be given with multiple granularity levels. For example, we can describe both the current activity and the current step within that activity (i.e. cooking and taking ingredients from fridge). However, it is challenging to evaluate the performance of the classifiers under this condition. This is because the evaluation has to consider many underlying challenges such as the dependence of one level to the other, the direction of this dependence and the impact of each level. These factors have a great impact for

assessing performance of classifiers. This work proposes two metrics for multi-level labels in a dataset considering these factors. We compare the metrics on a public dataset and show that they can assess the performance of a model classifying activities at two different granularity levels. Between the proposed metrics, a metric considering the co-occurrence matrix of correct predictions for both levels shows the best discrimination policy, with a difference between two classifier models of about 12%.

152: On Data Augmentation Techniques for Deep Learning Multi-class Segmentation of Lung Confocal Immunofluorescent Images

Daiki Katsuma (Mie University, Japan), Hiroharu Kawanaka (Mie University, Japan), Bruce J. Aronow (Cincinnati Children's Hospital Medical Center, USA), V. B. Surya Prasath (Cincinnati Children's Hospital Medical Center, USA)

Human lung development requires complex gene and cell interactions, and the lung development can be studied at gene, cellular, and molecular levels. Availability of multimodal imaging data of the lung can help us visualize protein and cell localization in various lung structures. In particular, confocal Immunofluorescence (IF) images can be used in lung development modeling and we require multi-class segmentation is an important requirement. However, it is difficult to obtain a sizeable number of training images in the multi-class segmentation with recent deep learning models such as the convolutional neural network (CNN) methods. Here, in order to improve the overall accuracy of multi-class segmentation in lung confocal IF images with generative adversarial network (GAN) based approach for data augmentations. By creating high fidelity synthetic images generated via lung confocal IF images, we mix the original and synthetically generated images for increasing the accuracy of the automatic segmentation. Our experimental results on a set of confocal IF images indicate we obtain good quality synthetic images that can be of use in deep CNN based segmentation models. We add the synthesized images to the training dataset and we obtained an extra improvement of 8.9% accuracy of six classes average.

192: Exploring the use of accelerometer for assisting weight lifting exercise

Nour Alhuda Albougha (Kyushu Institute of Technology, Japan), Brahim Benissa (Kyushu Institute of Technology, Japan), Sozo Inoue (Kyushu Institute of Technology, Japan)

One of the most important aspects of professional athleticism and rehabilitation is muscle activation. Although sport tracking technologies are advancing rapidly, existing technologies and devices for detecting muscle performance are still out of common users' hands, due to their complexity, invasive nature and high cost. However, sensor equipped devices are getting widely available, which opens the door to alternative solutions using software. In this work we explore the possibility of using accelerometer data for muscle performance in a weightlifting exercise. By investigating a predefined common weightlifting exercise, we exploited a correlation between the acceleration and the lifted weights using a simple RBF prediction method, in a real experiment where data obtained from three participants. The obtained results show that the weight could be predicted in acceptable accuracy for each individual, based on acceleration data.

Day 4: 29 August 2020

1200~1330: IVPR-6: Vision: Objects

201: Multi-Thread Approach to Object Detection Using YOLOv3

Rayan Abri (Hacettepe University/Mavinci Informatics Inc., Turkey), Sara Abri (Hacettepe University/Mavinci Informatics Inc., Turkey), Anil Yarici (Mavinci Informatics Inc., Turkey), Salih Çetin (Mavinci Informatics Inc., Turkey)

Recently, In the field of the object detection process, Convolutional Neural Network (CNN) methods have been applied as more efficient solutions. In the CNN methods, You Look Only Once, version 3 (YOLOv3) more powerful than classic CNN methods such as Fast-RCNN and Faster-RCNN in terms of accuracy and speed. Even though YOLOv3 can obtain more accuracy and speed compared to other CNN approaches, it needs to be used in a system with a powerful single Graphics Processing Unit (GPU). The YOLOv3 still requires the heavy computational cost to maintain good detection performance; it brings high computation overhead. It is needed to design a more stable algorithm to increase frames per second (fps) in the object detection process. The main contribution is proposing a Multi-thread approach that uses YOLOv3 to perform real-time object detection in the large scale of video streams. In this paper, we design a Multi-thread approach that uses YOLOv3 to perform real-time object detection with decreasing detection time per frame. In the proposed multi-thread approach, we aim to decrease the idle times between CPU and GPU. The proposed approach is evaluated using a public dataset and the result shows improvements in performance compared to the YOLOv3. The multi-thread model is evaluated on two different servers with two GPU cards and the results yield improvement by an average 26% in fps.

208: Triplet Network with Multi-level Feature Fusion for Object Tracking

Yang Cao (Xidian University, China), Bo Wan (Xidian University, China), Quan Wang (Xidian University, China), Fei Cheng (Xidian University, China)

In recent years, Siamese network-based trackers have received increasing interest because of the balanced accuracy and speed. However, these tracking methods only extract the high-level features as target representations and merely utilize the first frame as the exemplar branch, which are less discriminative to distinguish similar distractors and are vulnerable to background clutter. To address these issues, we propose a novel Triplet network with a multi-level feature fusion structure (TripMFF) to leverage the merits of Triplet network and fuse multi-layer features for robust object tracking. Firstly, the Triplet network is adopted as our backbone architecture to take full advantage of the correlation among frames in the video sequence and make the exemplar branches have more useful information. Secondly, in order to capture more abundant features, a multi-level feature fusion structure is put forward to combine the low-level fine-grained and high-level abstract information, which improves the discriminative capability and stability of the tracker. Experimental results on tracking benchmarks prove that our proposed method achieves competitive performance and real-time tracking speed compared with other state-of-the-art trackers.

11: BLPNet: An End-to-End Model Towards Voxelization Free 3D Object Detection

Zhihao Cui (University of Technology of Sydney, Australia), Zhenhua Zhang (University of Technology of Sydney, Australia)

Recent achievements in robotics application and autonomous navigation are accomplished through the fast progress in point cloud 3D object detection models. Many of the current single staged 3D object detection models rely heavily on the voxelization and PointNet based method for feature extraction. Although it provides an efficient way to process point cloud data, its lack of spatial and geometric relationships on both voxel and point level limited the detection accuracy of models. In this paper, we focus on these limitations of the voxelization based object detection pipeline and proposed a single-stage non-

voxelization 3D object detection framework. This framework utilizes the bilateral convolution layer, region based feature clustering and lattice to feature map layer to address the lack of spatial, and geometric relationships in both voxel and point level, which further improves 3D object detection accuracy on the KITTI dataset. Our method achieved 75.63 mAP in moderate difficulty and outperformed many influential object detection models on the KITTI benchmark leaderboard.

176: Deep Learning Based Surface EMG Hand Gesture Classification for Low-Cost Myoelectric Prosthetic Hand

Nazmun Nahid (University of Dhaka, Bangladesh), Arafat Rahman (University of Dhaka, Bangladesh), M.A.R. Ahad (University of Dhaka, Bangladesh)

In this paper, a comparative study of classifying different hand gestures of two well-known surface Electromyogram (sEMG) data sets, Rami Khusaba EMG repository, and UCI Machine Learning Repository, are shown. Applying transfer learning and CNN-LSTM neural network architectures, we find out a suitable control scheme for a myoelectric prosthetic hand (we mention it as DUFAB Hand). At first, the continuous wavelet transform is exploited to create images from sEMG signals, which serves as a powerful feature for the classification of different hand gestures. Then, we transferred the learning of various neural nets of image classification, e.g., AlexNet, and ResNet-18 to the sEMG image classification. Application of these deep neural networks outperformed general machine learning techniques with higher accuracy and performance. For example, the combination of CNN and LSTM has achieved the state-of-the-art accuracies for these data sets, of 99.23% for UCI Machine Learning Repository and 99.83% for Rami Khusaba EMG repository respectively. These results are promising and encourage new research and application of deep learning in sEMG hand gesture classification.

35: Weakly Supervised Semantic Roadside Object Segmentation Using Digital Maps

Johannes A.P. Guelen (Utrecht University, the Netherlands), Albert Ali Salah (Utrecht University, the Netherlands), Bastiaan J. Boom (CycloMedia Technology B.V., the Netherlands), Julien A. Vijverberg (CycloMedia Technology B.V., the Netherlands)

Publicly available digital maps may offer semantic information regarding objects in street view images. In this paper, we propose an approach to exploit such information to automatically create object detection datasets on which state-of-the-art object detection methods can be trained. To accomplish this, we use two detailed maps of the Netherlands containing the location of a large number of street objects. We link the object information to street view images to use them as image-wide labels. Our results show that even though there are many sources for noise in the labels, we can create useful data with this approach.

167: Polygonization of 3D Objects using Norm Similarity

Somrita Saha (Indian Institute of Engineering Science and Technology, India), Arindam Biswas (Indian Institute of Engineering Science and Technology, India)

This work proposes a method of polygonization of the surface of triangulated 3D digital objects by merging the edge-adjacent face triangles having similar norms. Least square method is applied to the boundary vertices of the set of the merged face triangles, which yields a new norm optimizing the norms of the individual face triangles constituting the merged set. The coordinates of the boundary vertices are recalculated with respect to this new norm. Finally, all the instances of each vertex is averaged to obtain the final coordinates. In this process, many of the vertices of the original input object are dropped, giving rise to a number of polygons describing the object, which is substantially less than the number of original face triangles. Thus, a considerable amount of compression is achieved. Also, polygons representing the object can reveal its structure and shape and are amenable to improved shape analysis.

1340~1440: IEV-IVPR-4: Communication and System

58: Circular Equivalent Planar Array- A new approach

G. M. Asadullah (International Islamic University Malaysia, Malaysia), Md. Shazzadul Islam (International Islamic University Malaysia, Malaysia), Md. Rafiqul Islam (International Islamic University Malaysia, Malaysia), Noor Hidayah M Adnan (International Islamic University Malaysia, Malaysia)

In this paper, a new configuration of four elements circular equivalent planar array has been proposed to achieve high gain and directivity with lower sidelobe level. After being designed and simulated, the proposed antenna array has achieved high directivity of 15.3 dBi with 85 % radiation efficiency. Besides, the array has a maximum realized gain of 14.51 dB and low sidelobe level of - 16 dB. The proposed antenna array has been evaluated by comparing its performances with four elements of MIMO and planar antenna arrays. It is observed that the proposed array shows greater performances in terms of all parameters compared to the other two arrays. Also, the proposed array has maximum isolation of below - 35 dB between two nearby elements. In turn, the high directivity of the proposed antenna array resonating at 5.8 GHz with very minimum return loss which makes it suitable for Radar application.

158: Design of High Gain Microstrip Array Antenna and Beam Steering for X Band RADAR Application

Liton Chandra Paul (Pabna University of Science and Technology, Bangladesh), Md. Ibnul Hasan (Pabna University of Science and Technology, Bangladesh), Rezaul Azim (University of Chittagong, Bangladesh), Md. Rashedul Islam (Universiti Kebangsaan Malaysia, Malaysia), Mohammad Tariqul Islam (Universiti Kebangsaan Malaysia, Malaysia)

High gain microstrip array antennas (1×2 , 1×4 and 2×4 elements) have been designed and analyzed for X band RADAR application. The array elements are excited by using inset feeding technique. Interesting, all the array antennas are tuned at exactly 10 GHz centre operating frequency. Rogers RT/duroid 5880TM having relative permittivity of 2.2 has been used as substrate for all the array antennas. Finally proposed 2×4 elements high gain array antenna shows gain of 15.5 dB and directivity of 15.82 dBi with return loss of -30.27 dB. The antenna covers frequency range of 9.77 GHz - 10.15 GHz, so bandwidth of it is 380 MHz. A beam steering of $(\theta, \phi) = (16^\circ, 0)$ with half power beam width (HPBW) of 16.88° is achieved using switched line phase shifter for 1×4 elements array antenna. Beam steering antenna shows return loss of -33.28 dB, very good VSWR of 1.04 and high bandwidth of 880 MHz. The ANSYS high frequency structural simulator (HFSS) has been used to perform all the simulations works.

147: Dissimilarity Based Regularized Deep Learning Model for Information Charts

Prerna Mishra (DSPM-IIITNR, India), Santosh Kumar (DSPM-IIITNR, India), Mithilesh Kumar Chaube ((DSPM-IIITNR, India)

The charts are very much convenient way to represent the complex data into simple pictorial based representation. Every chart type has variations in its characteristics, structure, and appearances making every type and subtype of chart different from each other on its physical outlook. Classification of such similar outlook charts still remains an untouched area. This paper presents a model that computes chart dissimilarity index, which is amalgamated with regularization on input layers of the learning model. Thus, all structural variations of charts are integrated into the model which produces 96.66% accuracy rate outperforming existing state-of-the-art models.

215: Suitability of Single-channel Acoustic Myography for Classification of Individual Finger Movements

Amirul Karim Tanim (University of Dhaka, Bangladesh), K M Talha Nahiyani (University of Dhaka, Bangladesh), M.A.R. Ahad (University of Dhaka, Bangladesh)

Acoustic Myogram (AMG) is the vibration or sound signal produced during muscle contraction and relaxation. A simple system like a condenser microphone is enough to capture an AMG signal from muscles, unlike complex systems that are used in surface Electromyography (sEMG). Moreover, AMG signal is not highly sensitive to sensor placement like sEMG signal. Therefore, Acoustic Myography is a potential research area to find an alternative to complex and bulky sEMG system. This work focuses on verifying the suitability of single-channel AMG for the classification of individual five finger movements. AMG data were recorded from 14 subjects at two different sites on hand, namely forearm muscle and wrist. Temporal, Spectral, and Cepstral features were extracted from the collected data after required pre-processing. Two Machine learning algorithms: Support Vector Machine and K-Nearest Neighbors were applied to classify the features. From this analysis, three main outcomes were achieved: Independent five finger movements cannot be differentiated precisely using single-channel AMG data solely, whether they are from the forearm or wrist. Class reduction and grouping of some fingers increase the classification accuracy, which infers that vibrations due to different finger movements have very similar attributes. AMG from both forearm and wrist yielded similar classification accuracy, with no evidence of a site being significantly better.

Cooking Activity Recognition Challenge 2020

261: SCAR-Net: Scalable ConvNet for Activity Recognition with multi-modal Sensor Data

Zabir Al Nazi (*Independent Researcher, Bangladesh*)

In recent times, context-aware activity recognition has made significant progress due to modern development of machine learning. Yet, it is challenging due to the major difference among each recognition tasks due to the change in sensor types, system design, bio-factors of the subjects, etc. In this work, a generalized solution has been presented for the Cooking Activity Recognition Challenge, where the model needs to predict the macro and micro activities from raw sensor data. The proposed Convolutional Neural Network (SCAR-Net [1,2]) is an end2end, multi-head model which can work with sensor data from multiple sensors at once without truncating or padding the time-series data. SCAR-Net also performs exceptionally well without any kind of pre-processing to the data. Proposed method is tested with leave-one-subject-out cross-validation metrics (accuracy) to validate models' performance. SCAR-Net 1 achieves 54% average accuracy for the macro activity recognition task with 3 classes and SCAR-Net 2 achieves 27% average multi-label accuracy for the micro activity recognition task with 10 classes. The source-code for the complete project is available at <https://github.com/zabir-nabil/activity-recognition-abc>.

262: Multi-class Multi-label Classification for Cooking Activity Recognition

Shkurta Gashi (*Università della Svizzera italiana (USI), Switzerland*), Elena Di Lascio (*Università della Svizzera italiana (USI), Switzerland*), Silvia Santini (*Università della Svizzera italiana (USI), Switzerland*)

In this paper we present an automatic approach to recognize cooking activities from accelerometer data. We rely on a dataset that contains three-axis acceleration data collected with three devices, including two wristbands, two smartphones and a motion capture system. The data is collected from three participants while preparing sandwich, fruit salad and cereal recipies. The participants performed several fine-grained activities while preparing each recipe such as, e.g., cut, peel. We propose to use multi-class classification approach to distinguish between cooking recipes and a multi-label classification approach to identify the fine-grained activities. Our approach achieves 81% accuracy to recognize fine-grained activities and 66% accuracy to distinguish between different recipes using leave-one-subject-out cross-validation. The multi-class and multi-label classification results are 27 and 50 percentage points higher than the baseline. We further show the effect on classification performance of different strategies to cope with missing data and show that imputing missing data with an iterative approach provides 3 percentage points increment to identify fine-grained activities. We confirm findings from the literature that extracting features from multi-sensors achieves higher performance in comparison to using single sensor features.

263: Identification of Cooking Preparation Using Motion Capture Data: A Submission to the Cooking Activity Recognition Challenge

Clément Picard (*Ecole normale supérieure de Rennes, France*), Vito Janko (*Jožef Stefan Institute, Slovenia*), Nina Rešić (*Jožef Stefan Institute, Slovenia*), Martin Gjoreski (*Jožef Stefan Institute, Slovenia*), Mitja Luštrek (*Jožef Stefan Institute, Slovenia*)

The Cooking Activity Recognition Challenge tasked the competitors with recognizing food preparation using motion capture and acceleration sensors. This paper summarizes our submission to this competition, describing how we re-ordered the training data, re-labeled it and how we hand-crafted features for this dataset. Our classification pipeline first detected basic user actions (micro-activities), using them it recognized the recipe, and then used the recipe to refine the original micro-activities predictions. After the post-processing step using a Hidden Markov Model, we achieved the competition score of 95% on the training data using cross-validation.

264: Multi-Sampling Classifiers for the Cooking Activity Recognition Challenge

Ninnart Fuengfusin (Kyushu Institute of Technology, Japan), Hakaru Tamukoh (Kyushu Institute of Technology, Japan)

We propose multi-sampling classifiers (MSC), a collection of multi-class and binary classifiers. To address the cooking activity recognition challenge (CARC), CARC consists of macro and micro labels. To deal with these labels, MSC uses a multi-class classifier to recognize the macro labels and 10 binary classifiers to examine whether each micro label exists. To shield the MSC model from sampling noise, we generate three distinct re-sampling rates of the temporal sensor data. All predictions of the three data sampling rates are gathered together using a soft-majority voting ensemble.

265: Activity Recognition from Skeleton and Acceleration Data Using CNN and GCN

Donghui Mao (Shandong University, China), Xinyu Lin (Shandong University, China), Yiyun Liu (Shandong University, China), Mingrui Xu (Shandong University, China), Guoxiang Wang (Shandong University, China), Jiaming Chen (Shandong University, China), Wei Zhang (Shandong University, China)

Most of the existing methods of activity recognition are based on singlelabel classification, however, these methods cannot be used in this challenge which focuses on multi-label classification based micro-activity recognition. To address this, we propose a GCN model using the binary cross entropy loss function, which enables multi-label classification and achieves average accuracy of 83.1% on the Cooking Activity Dataset. In addition, to utilize the advantages of multi-modal data, we propose a joint training CNN model that combines the acceleration and skeleton data together. Finally, the proposed CNN model achieves an average accuracy of 82.8% for macro-activity recognition on Cooking Activity Dataset.

266: Cooking Activity Recognition with Varying Sampling Rates using Deep Convolutional GRU Framework

Md. Sadman Siraj (University of Dhaka, Bangladesh), Omar Shahid (University of Dhaka, Bangladesh), Md. Atiqur Rahman Ahad (University of Dhaka, Bangladesh)

Activity recognition is one of the most researched topics in the field of machine learning-based recognition. There are many challenges associated with Human Activity Recognition. One of the most important challenges to overcome is the simultaneous recognition of complex activities as well as smaller activities that are part of such complex activities. The dataset that has been used and the work that has been done in this paper is part of the Cooking Activity Recognition Challenge. The dataset that has been provided in this challenge contains three classes of complex or macro activities and ten classes of smaller or micro activities. The macro activities are mutually exclusive whereas multiple micro activities can occur in a sequence as parts of a particular macro activity. The dataset is very challenging because of the recorded segments having varying sample rates among them for which we have pre-processed the data. In addition to that, the dataset contains several recorded segments with missing data. The task of this challenge has been to classify macro and micro activities separately from this dataset. We have introduced a deep learning framework combining CNN (Convolutional Neural Network) and GRU (Gated Recurrent Unit) to extract spatial and temporal features for recognition of macro and micro activities. The model that we have proposed for this dataset outperforms other conventional and existing deep learning models with classification accuracies of 83.76% and 59.39% for macro and micro activity classifications respectively.

268: Deep Convolutional Bidirectional LSTM for Complex Activity Recognition with Missing Data

Swapnil Sayan Saha (University of California, Los Angeles, USA), Sandeep Singh Sandha (University of California, Los Angeles, USA), Mani Srivastava (University of California, Los Angeles, USA)

Complex activity recognition using multiple on-body sensors is challenging due to missing samples, misaligned data timestamps across sensors, and variations in sampling rates. In this paper, we introduce a robust training pipeline that handles sampling rate variability, missing data, and misaligned data timestamps using intelligent data augmentation techniques. Specifically, we use controlled jitter in

window length and add artificial misalignments in data timestamps between sensors, along with masking representations of missing data. We evaluate our pipeline on the Cooking Activity Dataset with Macro and Micro Activities, benchmarking the performance of deep convolutional bidirectional long short-term memory (DCBL) classifier. In our evaluations, DCBL achieves test accuracies of 88% and 72% respectively for macro and micro-activity classification, exceeding performance over state-of-the-art vanilla activity classifiers.

269: Cooking Activity Recognition with Convolutional LSTM using Multi-label Loss Function and Majority Vote

Atsuhiro Fujii (Ritsumeikan University, Japan), Daiki Kajiwara (Ritsumeikan University, Japan), Kazuya Murao (Ritsumeikan University, Japan)

This paper reports the Cooking Activity Recognition Challenge by team Rit's cooking held in the International Conference on Activity and Behavior Computing (ABC 2020). Our approach leverages convolution layer and LSTM to recognize macro activities (recipe), and micro activities (body motion). For micro activity consisting of multiple labels in a segment, loss is calculated using BCEWithLogistsLoss function in PyTorch for each body part, and then the final decision is made by majority vote by the body part

270: Let's not make it complicated - Using only LightGBM and Naive Bayes for macro and micro activity recognition from a small dataset

Ryoichi Kojima (KDDI Research, Inc., Japan), Roberto Legaspi (KDDI Research, Inc., Japan), Kiyohito Yoshihara (KDDI Research, Inc., Japan), Shinya Wada (KDDI Research, Inc., Japan)

We propose a model that combines only simple techniques to meet the challenge of cooking activity recognition. The challenge dataset is basically small, consisting only of four subjects where three are used for training and one for validation. In order not to overfit the small training data, we employed two simple classifiers, LightGBM and Naive Bayes, which suited the task. To prevent leakage from other subject data during training, we used Leave One Subject Out cross validation. Further, we incorporated a postprocessing step wherein the Naive Bayes corrects the macro activity classification outcomes that have been derived by LightGBM, based on the combinations of macro and micro activities that are likely to occur. We hypothesized that this added postprocessing will improve the macro activity recognition, and with it our model may be able to adapt well and generalize to other small datasets. As a result, our proposed model achieved an average accuracy of 0.557 when classifying macro and micro activities from a small dataset.

272: Summary of the Cooking Activity Recognition Challenge

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Cooking Activity Recognition Challenge is organized as a part of ABC2020. In this work, we analyze and summarize the approaches of submissions of the Challenge. A dataset consisting of macro and micro activities, collected in Cooking scenario were opened to the public with a goal of recognizing both of these activities. The participant teams used the dataset and submitted their predictions of test data which was released on March 1st, 2020. The submissions of the teams were evaluated rigorously and the winning team achieved about 35.4% averaged accuracy for macro and micro activities.

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