



Dongyoung Kim, Ph.D.

Artificial intelligence for engineering and industry

Date of birth: 1987.05.26

AI professional @ Data Analytics Laboratory,
Samsung Life Insurance, Seoul, Republic of Korea

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EXPERIENCES

2020 – Current	Samsung Life Insurance /Seoul, South Korea AI professional at Data Analytics Laboratory.
2017 – 2019	Institute for Basic Science / Ulsan, South Korea Research Fellow at Center for Soft and Living Matter
2012 – 2016	Texas A&M University / College Station, Texas, U.S.A. Research Assistant
2010 – 2012	The University of Southwestern medical center / Dallas, Texas, U.S.A. (Research Assistant
2010 – 2012	The University of Texas at Dallas / Dallas, Texas, U.S.A. Research Assistant
2009 – 2010	Embedded Software Research Center / Deagu, South Korea Research Assistant
2010 – 2010	EOS Australia / Sydney, Australia Internship

EDUCATION

2012 – 2016	Texas A&M University, Ph.D. in Biomedical Engineering College station, Texas, USA
2010 – 2012	The University of Texas at Dallas, B.S. Electrical Engineering and Computer Sciences Richardson, Texas, USA
2006 – 2012	Kyungpook National University , B.S. Electrical Engineering and Computer Sciences Daegu, South Korea

PROJECTS

2020 - 2020

End-to-end Deep learning based Optical Character Recognition (Deep OCR) framework

- A framework converting optically acquired image data to character using a series of deep learning models.
- Sets of deep learning models were designed and developed for image to text conversion using a variety of deep learning techniques, i.e., convolutional neural network, generative adversarial network, graph convolutional network, recurrent neural network, attention network.
- An image preprocessing model was developed to remove noise and to correct optical conditions (Korea patent under review).
- An language model was developed to understand unstructured text data and to translate to a structured database (Korea patent under review).
- Deep learning based data simulator to train and test deep learning models (Korea patent filed, see details in **Deep learning based optical image acquisition simulator engine** below).
- Deliver the Front-End service from trained models via RESTful API and redis/celery.

Related Awards

- ICDAR SROIE leaderboard text localization 1st place (2020/12)
<https://rrc.cvc.uab.es/?ch=13&com=evaluation&task=1>
- ICDAR SROIE leaderboard text recognition 1st place (2020/12)
<https://rrc.cvc.uab.es/?ch=13&com=evaluation&task=2>

Task 1 - Text Localization Task 2 - Scanned Receipt OCR Task 3 - Key Information Extraction

method: Samsung Life Insurance 2020-10-16

Authors: Dongyoung Kim, Myungseung Kwak
Affiliation: Data Analytics Laboratory (DA Lab), Samsung Life Insurance

Description: A document Text Localization Generative Adversarial Nets (TLGAN) model is utilized to perform the text localization task using SROIE data set. TLGAN learns text image features via ImageNet pre-trained VGG network in adversarial manner and points out text locations. Note the images were scaled in an arbitrary ratio and the detected coordinates were re-scaled into original image space for the submission.

Kim, D., Kwak, M., Yoon, E., Shim, S., & Nam, J. (2020). TLGAN: document Text Localization using Generative Adversarial Nets. <https://arxiv.org/abs/2010.11547>

Date	Method	Recall	Precision	Fmean
2020-10-16	Samsung Life Insurance	98.04%	99.03%	99.23%
2020-08-10	BOE_AioT_CTO	98.76%	98.92%	98.84%
2019-04-22	SCUT-DLVC-Lab-Refinement	98.64%	98.53%	98.59%
2019-04-22	Ping An Property & Casualty Insurance Company	98.60%	98.40%	98.50%
2019-04-22	H&H Lab	97.93%	97.95%	97.94%
2020-09-27	only PAN	96.51%	96.00%	96.66%
2019-04-22	GREAT-OCR Shanghai University	96.62%	96.21%	96.42%
2019-04-23	BOE_JDT_ABD	95.95%	95.99%	95.97%
2019-04-23	EM_ocr	95.85%	96.08%	95.97%
2019-05-10	Cleora OCR	96.04%	95.79%	95.92%

Task 1 - Text Localization Task 2 - Scanned Receipt OCR Task 3 - Key Information Extraction

method: Samsung Life Insurance 2020-10-16

Authors: Dongyoung Kim, Myungseung Kwak
Affiliation: Data Analytics Laboratory (DA Lab), Samsung Life Insurance

Description: A set of convolutional neural networks (CNNs) and recurrent neural networks (RNNs) were configured to perform the text recognition task using SROIE data set. Features produced from CNN-RNN models were interpreted to the text using an attention mechanism. We further process the data using a language model (LM) to find the best answer.

Date	Method	Recall	Precision	Fmean
2020-10-16	Samsung Life Insurance	96.60%	96.46%	96.57%
2019-04-22	H&H Lab	96.35%	96.52%	96.43%
2020-10-16	Samsung Life Insurance	95.04%	94.82%	94.93%
2019-04-22	HerReceipt-Ensemble	94.56%	95.10%	94.82%
2020-05-15	Hanoi University of Science and Technology - MSOLab	94.77%	94.88%	94.82%
2020-06-11	Hanoi University of Science and Technology - MSOLab	94.73%	94.81%	94.77%
2019-04-22	Ping An Property & Casualty Insurance Company	94.48%	94.86%	94.67%
2019-04-22	CLOVA OCR	94.30%	94.88%	94.59%

Related Patents

- Dongyoung Kim, et al. METHOD FOR MANAGING TRAINING DATA FOR OPTICAL CHARACTER RECOGNITION, Korea Patent Filed 1020200059652, 2020.
- Two more Korea patent under review (Image preprocessing approach, Unstructured data understanding)

Related Publications

- Kim, D., Kwak, M., Won, E., Shin, S., & Nam, J. TLGAN: document Text Localization using Generative Adversarial Nets. Arxiv 2010.1154, 2020.

Related News

- The Chosun Ilbo newspaper (조선일보) 2010. 10. 29. 서류 지옥서 구해준 '딥러닝 OCR'에 세계가 '엄지 척'

<https://lnkd.in/gHGecmr>

Money&Trend

조선일보 특집 / Advertorial section



삼성생명의 문자인식기술
OCR
(Optical Character Recognition)이
국제표준인식협회(IAAP)가
주관하는 ICAR
포바스트 리딩 컴퍼티션
(Robust Reading Competition)
2개 부문에서
1위를 기록한다.
ICAR
포바스트 리딩 컴퍼티션은
문자인식기술 분야에서
가장 권위있는
국제경진대회다.
많은 유망한 기술들이
참가하고 있으며
총 17개 부문으로 진행된다.



서류 지옥서 구해준
'딥러닝 OCR'에
세계가 '엄지 척'

삼성생명

세계적 권위 경진대회서 1위
저지 개발 1년 4개월만에 완성해
출 4월부터 실제 심사 업무에 도입
절약된 시간은 고액 마케팅에 활용

삼성생명은 이 중 2개 부문, 2개 과목에 참여했다. 이번 삼성생명 OCR이 최고평가를 받은 것은 1위로 알려진 국제표준인식협회 주관의 ICAR가 있지만 ICAR와 동일본, ISH LAB에 의해 평가된 '딥러닝 OCR'은 이 대회에서 2개 과목에서 최고평가를 기록하며 1위를 차지했다. 스캔된 수천 장의 이미지를 주고 글자의 위치를 찾는 과제(text localization)에서 98.23점을 기록해 기존 최고기록인 ICAR의 98.84점을 넘어섰고 문자를 읽어내는 과제(Scanned receipt OCR)에서는 최고점인 96.57점을 기록하며 세계 최고 수준임을 입증했다.

삼성생명은 업계 최초로 OCR 기술을 자체 개발한 4개의 특허를 취득했다. 서류 검색, 유통 업무 효율화하기 위해 삼성생명은 2018년부터 딥러닝 기술을 사용한 OCR 엔진인 '딥(Deep) OCR'을 개발했다. 기존의 OCR 기술은 위치 기반으로 작동하여 문서 안에서 초점만 벗어나도 인식이 되지 않는다는 단점이 있었다. 문서 앞뒤가 바뀌면 문장을 서로 연결해야 하기 때문에 효율성이 떨어졌다.



삼성생명의 2차원 바코드 문자인식 기술 OCR(2D Barcode Character Recognition)이 국제표준인식협회 주관의 ICAR에서 1위를 기록하며 세계 최고 수준임을 입증하게 됐다. 삼성생명은 딥(Deep) OCR 기술을 보유한 청구서류 처리 업무 등 실제 심사 업무에 활용하고 있다. 그동안에는 보험금 청구서 제출하는 서류들을 분류하기 위해 심사업무 직원들의 수작업으로 처리되었으나 4월부터 딥(Deep) OCR을 활용하여 자동화했다. OCR

기술로 98.23점의 우수성을 기록하고 우수성을 인정받았다. 삼성생명은 딥(Deep) OCR 기술을 도입한 이래 4월 1일부터 실제 심사 업무에 활용하고 있다. 그동안에는 보험금 청구서 제출하는 서류들을 분류하기 위해 심사업무 직원들의 수작업으로 처리되었으나 4월부터 딥(Deep) OCR을 활용하여 자동화했다. OCR

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2020 – 2020	<p>Deep learning based optical image acquisition simulator engine</p> <ul style="list-style-type: none">- Simulating optically acquired images using generative adversarial networks.- Supporting data simulation and management via light memory database- Only needs single image to learn the image features and to reproduce similar optical looks.- Realize the automation in deep OCR model training and testing. <p>Related Patents</p> <ul style="list-style-type: none">- Dongyoung Kim, et al. METHOD FOR MANAGING TRAINING DATA FOR OPTICAL CHARACTER RECOGNITION, Korea Patent Filed 1020200059652, 2020.
2020 – 2020	<p>AI data/model management platform</p> <ul style="list-style-type: none">- A Platform to train, to experiment, and to sever deep learning model with data management capability.- A data management system with rapid and efficient light memory database.- MLFLOW to mage models and experiments.- Redis/celery to serve models from experiments.- Supporting RESTful AP with a web based front service.
2020 – Current	<p>Finance Knowledge Digitalization for AI based QA Engine</p> <ul style="list-style-type: none">- A research to make an AI-usable data foundation of the product manuals and the knowledge management system (KMS).- Development of the financial knowledge digitalization and search framework (ARK API: artificial intelligent readable knowledge search API).- A data foundation development supporting RDB and GraphDB.- A framework design to support in-house models and other programs including IR search (Elastic search and/or IR models: TF-IDF, BM25), MRC (BERT, Electra), GPT, and Graph query models.- Serving as AI application (AI consultant QA, Chatbot QA, semantic search) and supporting multimodal AI knowledge processes.- Making pretrain BERT model using the product manuals and the knowledge management system (KMS) with the domain specific vocabulary.

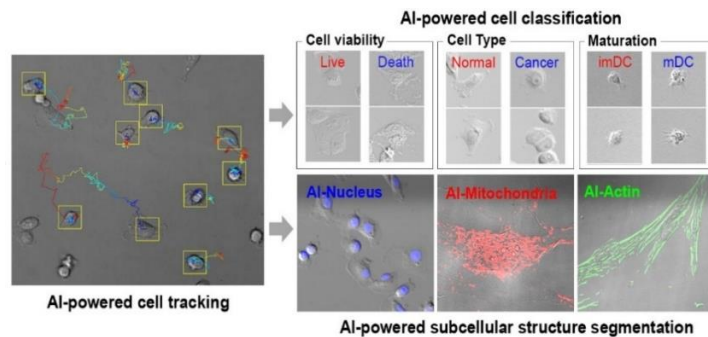
2020 –
Current

Finance Knowledge Graph

- Build finance knowledge graph to support QA system.
- Property graph design using Apache TinkerPop and Gremlin.
- Semi-automated conversion of RDB to GraphDB of KMS and product manual defining a higher structure resolution of the documents.
- Graph IR search and Graph semantic search model design.
- Graph multi-hop MRC model development.

2017 – 2019

AI-powered transmitted light microscopy for functional analysis of live cells



- Transforming a transmitted light microscopy image into a fluorescence microscopy equivalent image (or information) using unsupervised machine learning and supervised semantic segmentation.
- Real-time monitoring of living cell property and status from transmitted light microscopy video using region proposal convolutional neural network and convolutional neural network.
- Living cell tracking in time-lapse video using complementary learning of object shape and colors online.

Related Patents

*Dongyoung Kim, et al. GENERATING METHOD FOR SPECIALIZED MICROSCOPE IMAGES USING ARTIFICIAL NEURAL NETWORK AND IMAGE PROCESSING APPARATUS. Korea Patent 1020846820000, 2020.

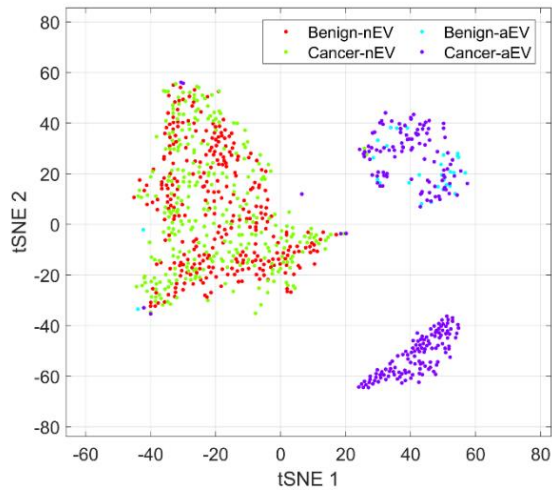
*Dongyoung Kim, et al. ANALYSING METHOD FOR CELL IMAGE USING ARTIFICIAL NEURAL NETWORK AND IMAGE PROCESSING APPARATUS FOR CELL IMAGE. Korea Patent 1020846830000, 2020.

Related publications

*Kim, D., Min, Y., Oh, J.M. et al. AI-powered transmitted light microscopy for functional analysis of live cells. Sci Rep 9, 18428 (2019) doi:10.1038/s41598-019-54961-x

2019 – 2020

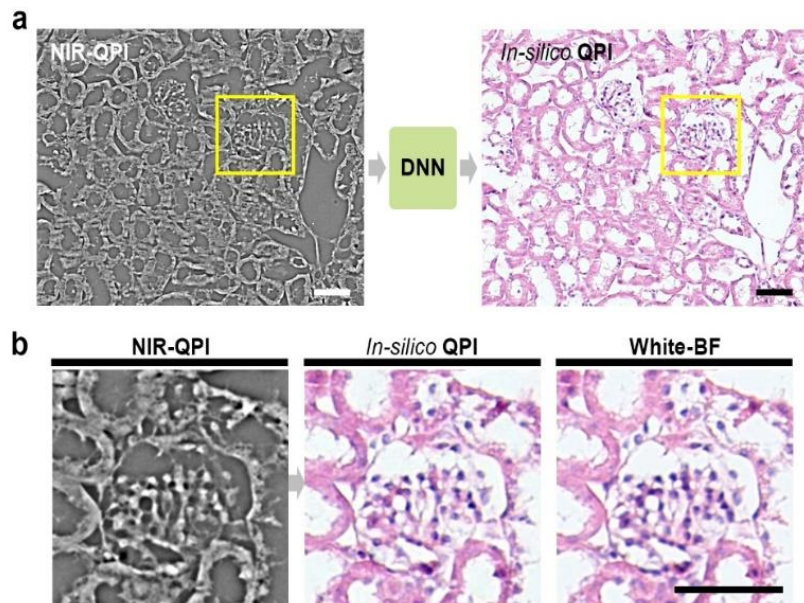
Searching extreme rare cancer extracellular vesicle in blood plasma using generative adversarial network



- A deep learning-based approach to detect ultra-rare cancer signal from blood.
- *Manuscript under preparation (2020).

2019 – 2020

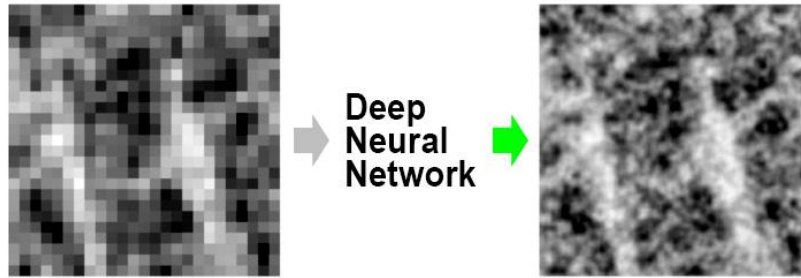
In-silico histology staining using generative adversarial network



- Generative adversarial network to visualize histology stains from substance's phase information.
- *Manuscript submitted (2020).

2019 - 2020

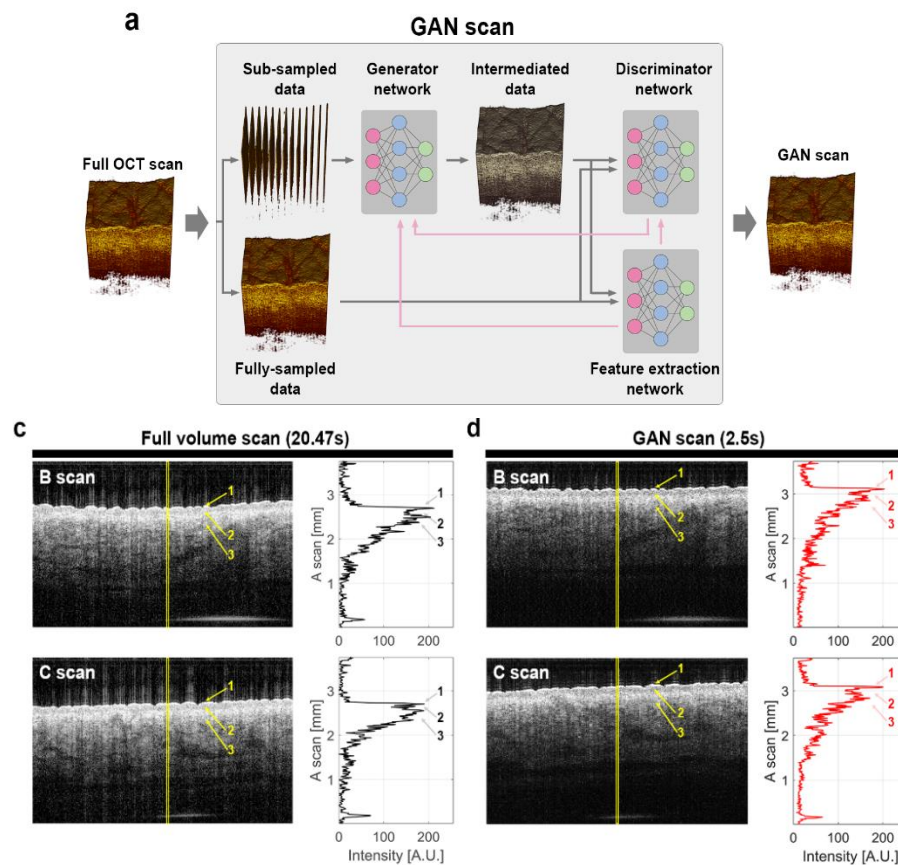
Generative adversarial network for high-definition medical image



- A modality to enhance resolution of medical tomographic images using generative adversarial network.
- *Manuscript under preparation (2020).

2019 - 2020

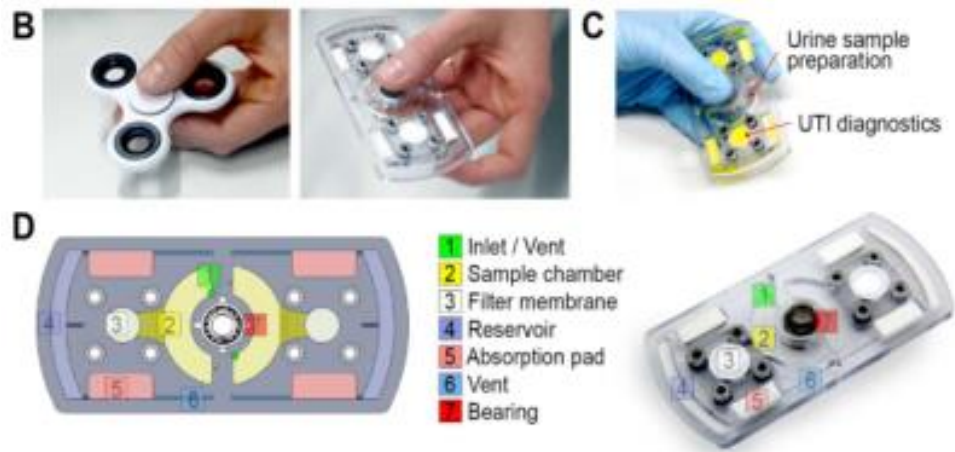
Generative adversarial network for rapid medical image acquisition



- A modality to reduce medical tomographic imaging time by 1/10 using generative adversarial network.
- *Manuscript submitted (2020).

2017 – 2020

A fidget spinner for the point-of-care diagnosis of urinary tract infection



- Hand-powered microfluidic system for bacterial cell enrichment.
- Urinary tract infection diagnosis from a cell phone photograph of a testing kit with machine learning techniques.

Related Patents

- Dongyoung Kim, et al. CENTRIFUGAL FORCE BASED NON-POWERED PARTICLE CONCENTRATION APPARATUS AND METHOD OF PARTICLE CONCENTRATION. Korea Patent 1021037840000, 2020.
- Dongyoung Kim, et al. CENTRIFUGAL FORCE BASED PLATELET ISOLATION AND TESTING SYSTEM. Korea Patent 1020638650000, 2020.

Related Publications

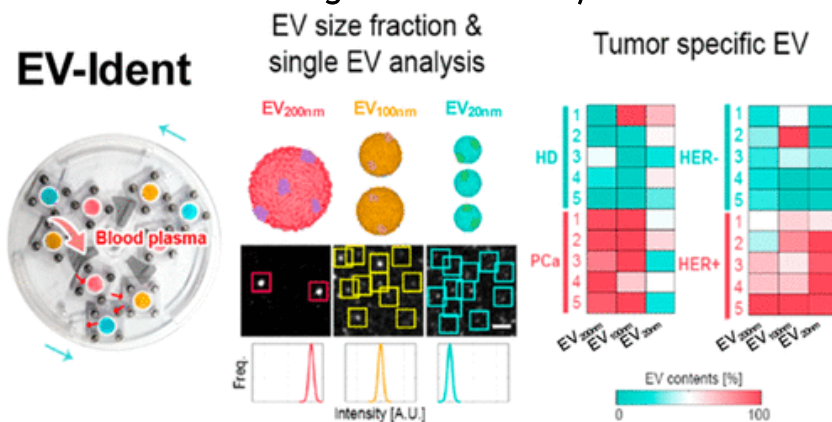
*Kim, D., Michael, I., Gulenko, O., Kumar, S., Kumar, S., Clara, J., ... Cho, Y.-K. (2020). A fidget spinner for the point-of-care diagnosis of urinary tract infection. *Nature Biomedical Engineering*. <https://doi.org/10.1038/s41551-020-0557-2>

Related News

- Korea MBC News “장난감 원리로 감염진단... 피젯 스피너의 변신” (2020)
- U.S. NewScientist News “Fidget spinner device can diagnose UTIs in under an hour without a lab” (2020)

2017 – 2020

EV-Ident: Identifying Tumor-Specific Extracellular Vesicles by Size Fractionation and Single-Vesicle Analysis



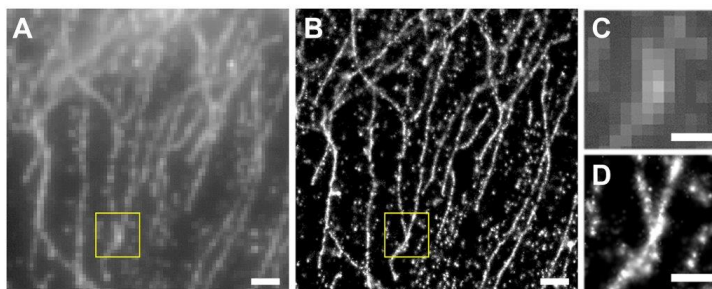
- Early cancer prediction from blood born particle using machine learning techniques.
- Extremely accurate protein marker expression measures by photon counting of particle optical image modeling / localization optimization.
- Identify cancer marker via unsupervised and supervised machine learning.

Related Publications

*Kim, D., Woo, H.-K., Lee, C., Min, Y., Kumar, S., Sunkara, V., ... Cho, Y.-K. (2020). EV-Ident: Identifying Tumor-Specific Extracellular Vesicles by Size Fractionation and Single-Vesicle Analysis. *Analytical Chemistry*, 92(8), 6010–6018. <https://doi.org/10.1021/acs.analchem.0c00285>

2012 – 2015

Three-dimensional super resolution microscopy



- An optical microscopy technique resolving fluorescently labeled features in ~5 nm resolution.
- Multifocal plane microscopy enables three-dimensional super-resolving imaging/ Multicolor imaging and super-precision chromatic/spatial registration are capable.

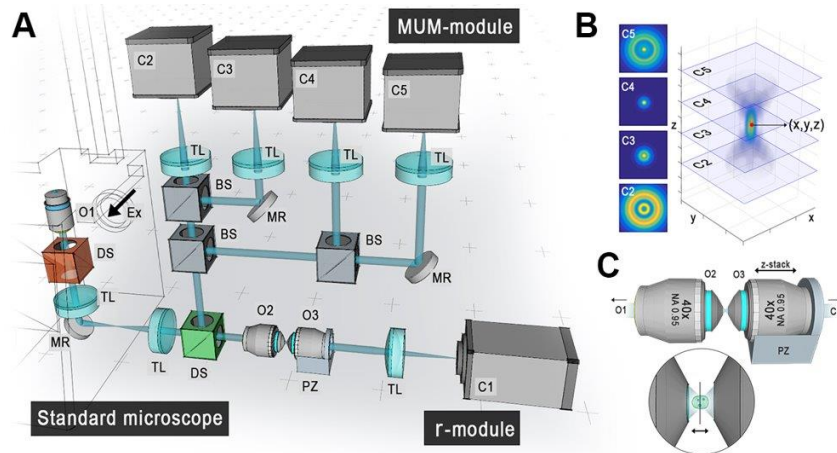
Related Publications

*Cohen E. A. K., Kim D., Ober R.J, Cramer-Rao Lower Bound for Point Based Image Registration with Heteroscedastic Error Model for Application in Single Molecule Microscopy. IEEE Transactions on Medical Imaging 2015

*Ram S, Kim D, Ober RJ, Ward ES. 3D Single Molecule Tracking with Multifocal Plane Microscopy Reveals Rapid Intercellular Transferrin Transport at Epithelial Cell Barriers. Biophysical Journal 2012

2014 – 2016

Remote focusing multifocal plane microscopy for the imaging of 3D single molecule dynamics with cellular context



- A microscopy modality to visualize three-dimensional single molecule trajectory in a context of three-dimensional and multicolor cellular structures and compartments over time.

Related patents

- Dongyoung Kim, et al. **ADVANCED MULTI-DIMENSIONAL MICROSCOPY SYSTEM FOR SINGLE PARTICLE & STRUCTURE IMAGING.** U.S. Patent, 2017.

Related publications

*Kim, D., Chao, J., Velmurugan, R., You, S., Ward, E. S., and Ober, R. J. **Remote focusing multifocal plane microscopy for the imaging of 3D single molecule dynamics with cellular context.** Proceedings of the SPIE, Three-Dimensional and Multidimensional Microscopy: Image Acquisition and Processing XXIV, 10070: 2017.

*Kim D, You S, Ward E.S., Ober R.J, **Imaging of three-dimensional single molecule dynamics with cellular context: Antibody trafficking and interaction with cell membrane and sorting endosomes.** ASCB, San Fransisco, CA. 2016.

*Cohen E. A. K., Kim D., Ober R.J, Cramer-Rao Lower Bound for Point Based Image Registration with Heteroscedastic Error Model for Application in Single Molecule Microscopy. IEEE Transactions on Medical Imaging 2015

PATENTS

Dongyoung Kim, et al. METHOD FOR MANAGING TRAINING DATA FOR OPTICAL CHARACTER RECOGNITION, Korea Patent Filed 1020200059652, 2020.

Dongyoung Kim, et al. GENERATING METHOD FOR SPECIALIZED MICROSCOPE IMAGES USING ARTIFICIAL NEURAL NETWORK AND IMAGE PROCESSING APPARATUS. Korea Patent 1020846820000, 2020.

Dongyoung Kim, et al. ANALYSING METHOD FOR CELL IMAGE USING ARTIFICIAL NEURAL NETWORK AND IMAGE PROCESSING APPARATUS FOR CELL IMAGE. Korea Patent 1020846830000, 2020.

Dongyoung Kim, et al. CENTRIFUGAL FORCE BASED NON-POWERED PARTICLE CONCENTRATION APPARATUS AND METHOD OF PARTICLE CONCENTRATION. Korea Patent 1021037840000, 2020.

Dongyoung Kim, et al. CENTRIFUGAL FORCE BASED PLATELET ISOLATION AND TESTING SYSTEM. Korea Patent 1020638650000, 2020.

Dongyoung Kim, et al. ADVANCED MULTI-DIMENSIONAL MICROSCOPY SYSTEM FOR SINGLE PARTICLE & STRUCTURE IMAGING. U.S. Patent, 2017.

HONORS & AWARDS

2020	IEEE ICDAR SROIE text localization task, 1 st place https://rrc.cvc.uab.es/?ch=13&com=evaluation&task=1
2020	IEEE ICDAR SROIE text recognition task, 1 st place https://rrc.cvc.uab.es/?ch=13&com=evaluation&task=2
2018	The 22 nd International Conference On Miniaturized Systems For Chemistry And Life Sciences , Shark Tank Competition, 1 st place
2016	Swiss SMLMS Challenge (EPFL) 3D single molecule localization microscopy, 1 st place
2014 – 2016	Texas A&M University Research Fellowship
2012 – 2014	The University of Texas at Dallas Research Fellowship
2011 – 2011	The University of Texas at Dallas Undergraduate Research Fellowship
2011 – 2011	The University of Texas at Dallas Senior Design Project, 2 nd place
2010 – 2012	The University of Texas at Dallas Undergraduate scholarship

LANGUAGES

Korean Native, English Fluent

SKILLS

Deep learning	Deep learning-based image processing model developments and service deployment. Deep learning-based language model developments and service deployment. Machine learning model management framework design and service. Deep learning model quantization and distillation.
Programming	Python, MATLAB, C, C++, JAVA, JavaScript, HTML.
Database	SQLite, MongoDB, GraphDB (Gremlin, Tinkerpop, Neo4j)
Library	Tensorflow, Keras, Pytorch, OpenCV Git, MLFlow, Docker
Control systems	NI LabWindows/CVI (C based control system IDE), NI LabView.
Optical system developments	Zemax based optical system design, Multimodal optical system configuration. Epifluorescence, TIRF microscopy, Confocal microscopy, Single molecule microscopy, super-resolution microscopy, Transmitted/scanning electron microscopy

LECTURES

BME21101 Introduction to biomedical engineering (Introduction to artificial intelligence for biomedical engineering / Introduction to deep learning), 2019, Ulsan National Institute of Science and Technology (UNIST).

PUBLICATIONS

Kim, D., Kwak, M., Won, E., Shin, S., & Nam, J. TLGAN: document Text Localization using Generative Adversarial Nets. Arxiv 2010.1154, 2020.

Kim, D., Woo, H.-K., Lee, C., Min, Y., Kumar, S., Sunkara, V., ... Cho, Y.-K.. EV-Ident: Identifying Tumor-Specific Extracellular Vesicles by Size Fractionation and Single-Vesicle Analysis. Analytical Chemistry, 92(8), 6010–6018, 2020.

Kim, D., Michael, I., Gulenko, O., Kumar, S., Kumar, S., Clara, J., ... Cho, Y.-K.. A fidget spinner for the point-of-care diagnosis of urinary tract infection. Nature Biomedical Engineering, 2020.

Kim, D., Min, Y., Oh, J.M. et al. AI-powered transmitted light microscopy for functional analysis of live cells. Sci Rep 9, 18428, 2019.

Sunkara, V., Kim C., Park J., Woo H., Kim D., Ha H., Kim M., Son Y., Kim J., Cho Y., Fully automated, label-free isolation of extracellular vesicles from whole blood for cancer diagnosis and monitoring. Theranostics, 2019.

Michael I., Kumar S., Oh J., Kim D, Kim J., Cho Y. Surface Engineered Paper Hanging Drop Chip for 3D Spheroid Culture and Analysis. ACS applied materials & interfaces, 2018.

Li, R., Chiguru, S., Li, L., Kim, D., Velmurugan, R., Kim, D., Tian, H., Schroit, A., Mason, R., Ober, R. J. and Ward, E. S. Targeting phosphatidylserine with calcium-dependent protein-drug conjugates for the treatment of cancer. Molecular Cancer Therapeutics, 2018.

Devanaboyina, S. C., Khare, P., Challa, Kim, D., Ober, R. J., and Ward, E. S. Engineered clearing agents for the selective depletion of antigen-specific antibodies. Nature Communications, 2017.

Kim, D., Chao, J., Velmurugan, R., You, S., Ward, E. S., and Ober, R. J. Remote focusing multifocal plane microscopy for the imaging of 3D single molecule dynamics with cellular context. Proceedings of the SPIE, Three-Dimensional and Multidimensional Microscopy: Image Acquisition and Processing XXIV, 10070: 2017.

Vahid, M. R., Chao, J., Kim, D., Ward, E. S., and Ober, R. J. State space approach to single molecule localization in fluorescence microscopy. Biomedical Optics Express, 2017

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