

Research Topics

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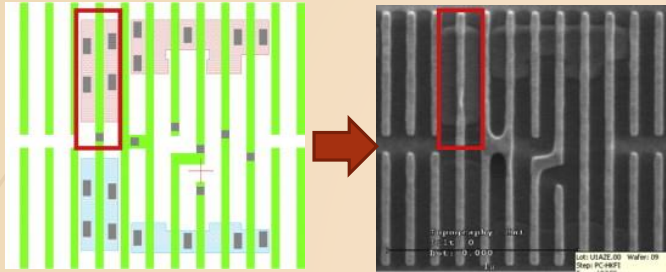
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About Me

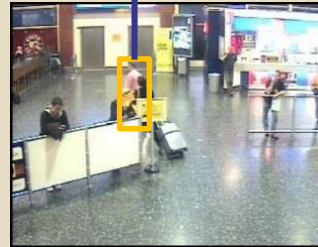
- ▶ Prof. Chia-Wen Lin (<http://www.ee.nthu.edu.tw/cwlin>)
 - ▶ Ph.D. in Electrical Engineering, National Tsing Hua University (NTHU) in 2000.
 - ▶ IEEE Fellow (Class of 2018)
 - ▶ IEEE CASS Fellow Evaluating Committee member (2021)
 - ▶ Distinguished Lecturer, IEEE Circuits & Systems Society (2018/1~2019/12)
 - ▶ Affiliation:
 - ▶ Professor, Dept. Electrical Engineering, NTHU
 - ▶ Deputy Director of NTHU AI Research Center
 - ▶ Director, Multimedia Technology Research Center, EECS College, NTHU
 - ▶ Professional Services
 - ▶ Associate Editor: IEEE Trans. Image Processing (2017~2020), IEEE Trans. Circuits & Systems for Video Tech. (2009~2013), IEEE Trans. Multimedia (2011~2014), IEEE Multimedia Magazine (2012~2015)
 - ▶ TPC Chair IEEE ICIP 2019 & General Chair, IEEE VCIP 2018
 - ▶ Research team: 4 PhD students + 16 master students

IC Fabrication



Security

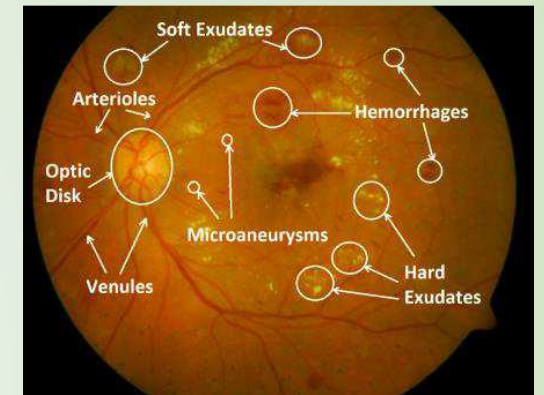
The same?



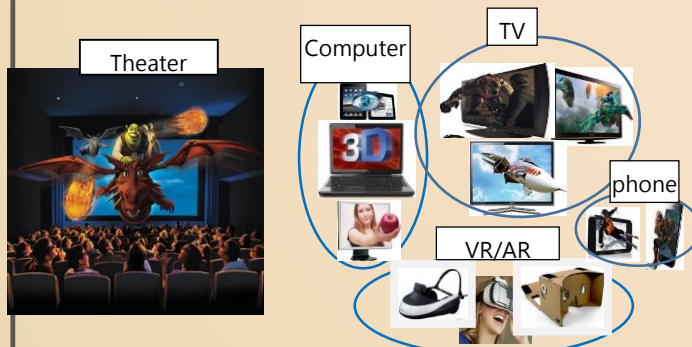
Camera a

Camera b

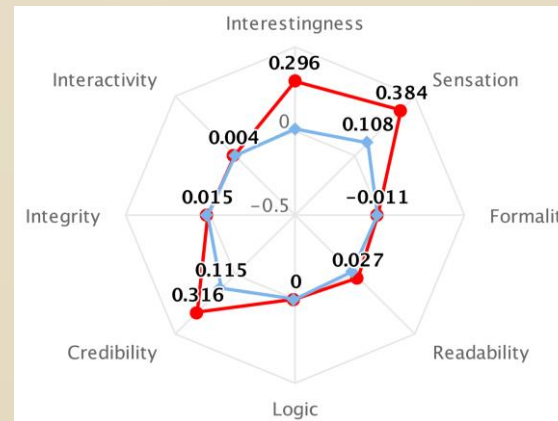
Healthcare



Media Adaptation



Social Media



Fashion



Ongoing Research Topics

- Few-Shot Learning for Computer Vision and Image Processing (MOST, LiteOn)
- Face Synthesis for Boosting Face Recognition (MOST, LiteOn)
- Deep Learning for Simulating IC Fabrication (Lithography and OPC) (UMC)
- Machine Learning-based CV Applications for Mobile Phones (Qualcomm)
- GSP for CV Applications (York U., Canada)
- Terahertz Tomographic Imaging (NTHU)
- 360° Video Stitching, Dewarping, and Super-resolution for High-Quality Video Conferencing (Logitech, finished in 2020)
- Retina Image Analysis (ITRI, finished in 2020)

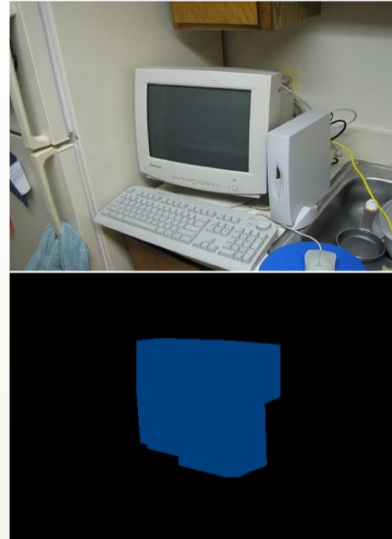
Low-Shot Learning for CV Applications

Low-Shot (few-, one-, zero-shot) Learning Problems:

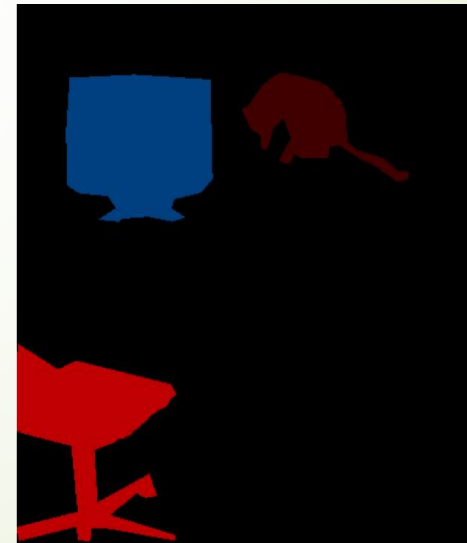
- Low Labeling Resource
- Small Training Set
- Unbalanced (Biased) Training Data
- Label Noise
- Domain Shift



Input



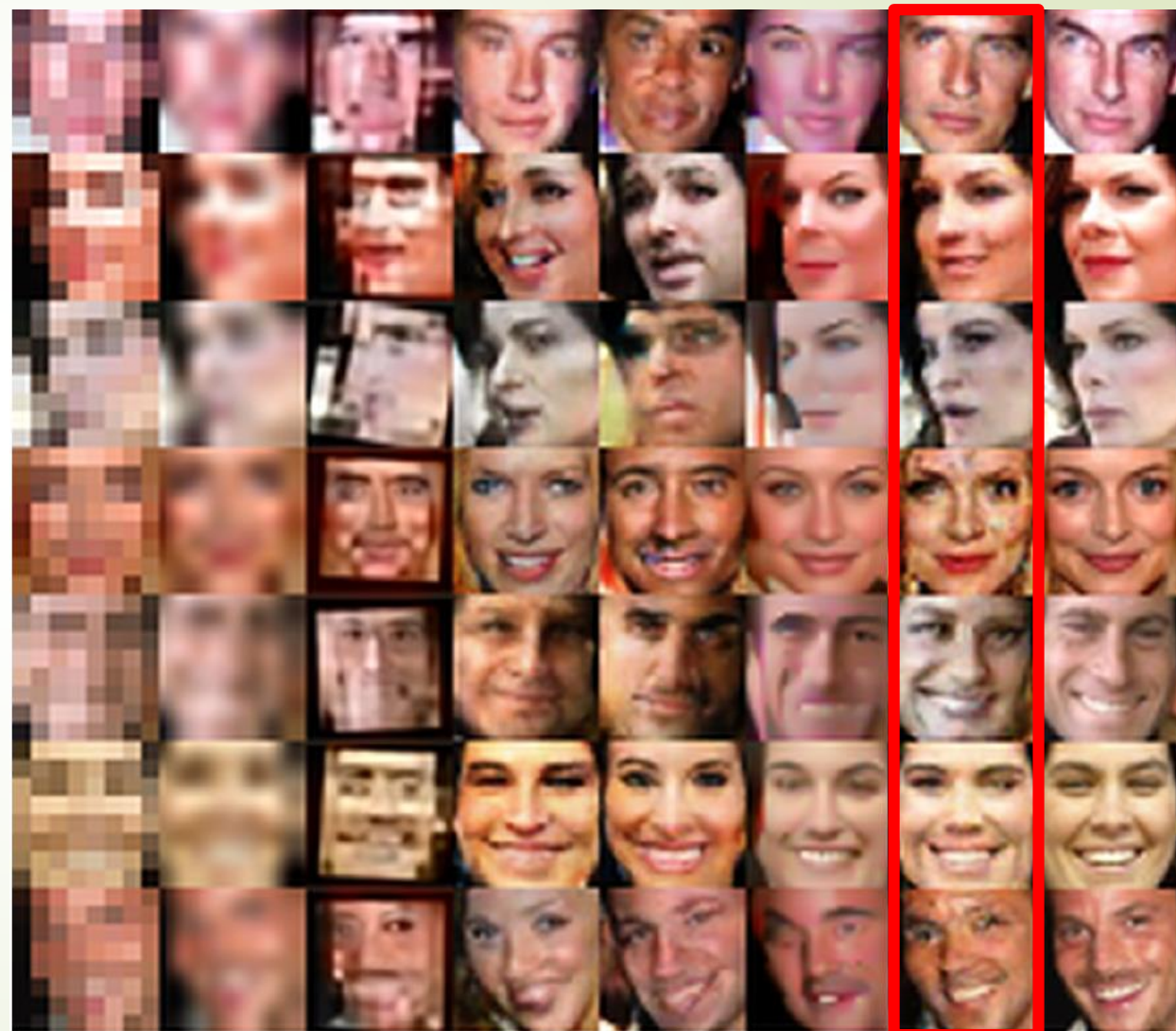
Novel Class



Result

Identity-Preserving Face Hallucination GAN

Methods	8×8 to 32×32	16×16 to 64×64
HR	83.3%	92.7%
LR	64.1%	64.3%
Bicubic	64.8%	63.7%
CBN [9]	62.6%	62.2%
UR-DGN [8]	64.5%	67.7%
DCGAN [6]	60.9%	60.8%
PRSR [2]	70.0%	71.1%
SiGAN (proposed)	80.1%	81.9%

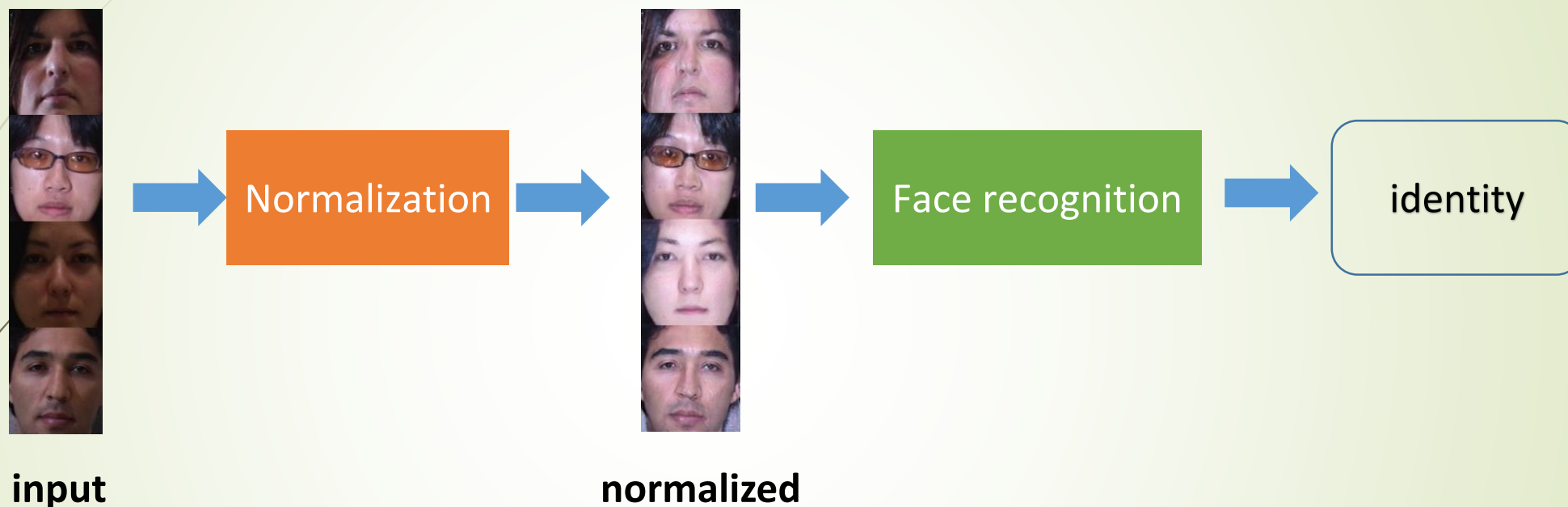


Input

Proposed Real

C.-C. Hsu, C.-W. Lin*, W.-T. Su, and G. Cheung, “SiGAN: Siamese generative adversarial network for identity-preserving face hallucination,” *IEEE T-IP* Dec. 2019.

Face Normalization & Augmentation for Face Recognition (LiteOn)

LITEON

Data Augmentation

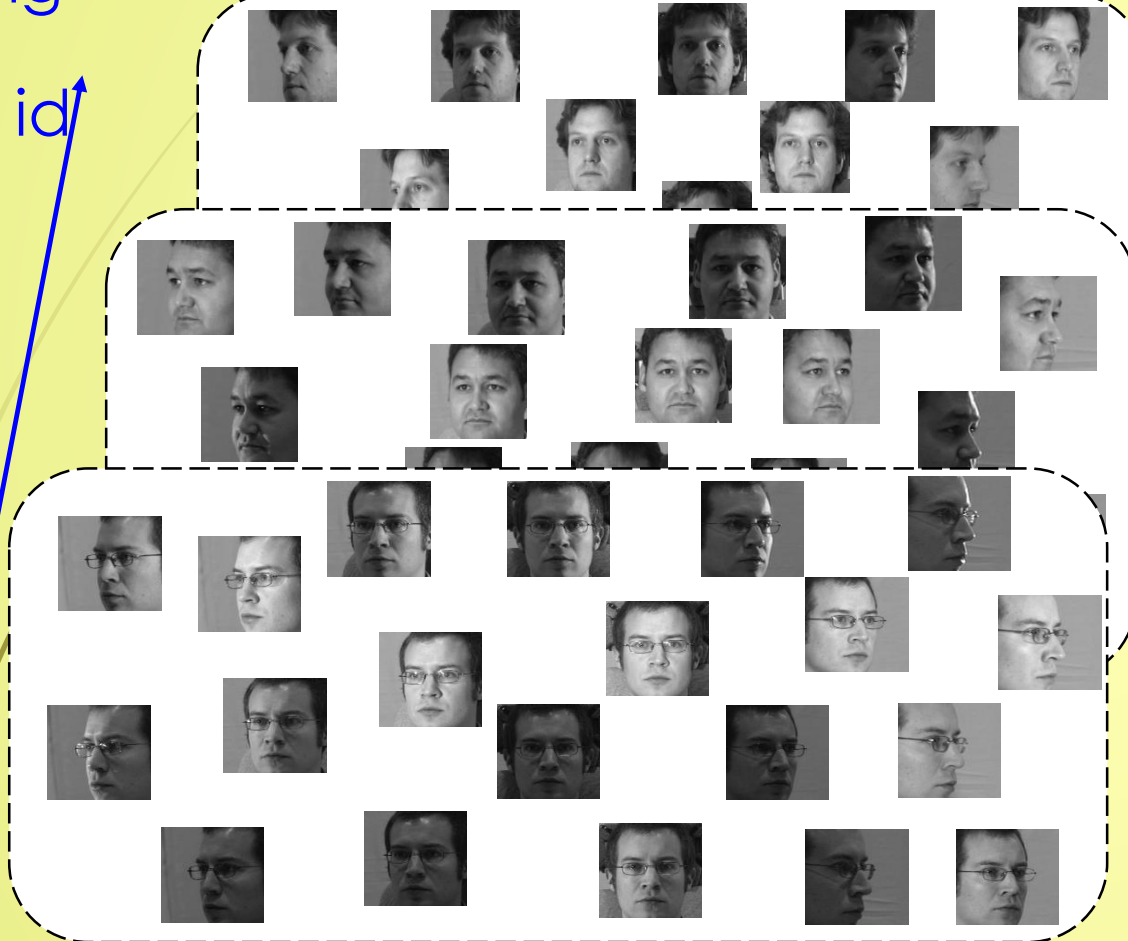


Face Augmentation

LITEON

lighting

id



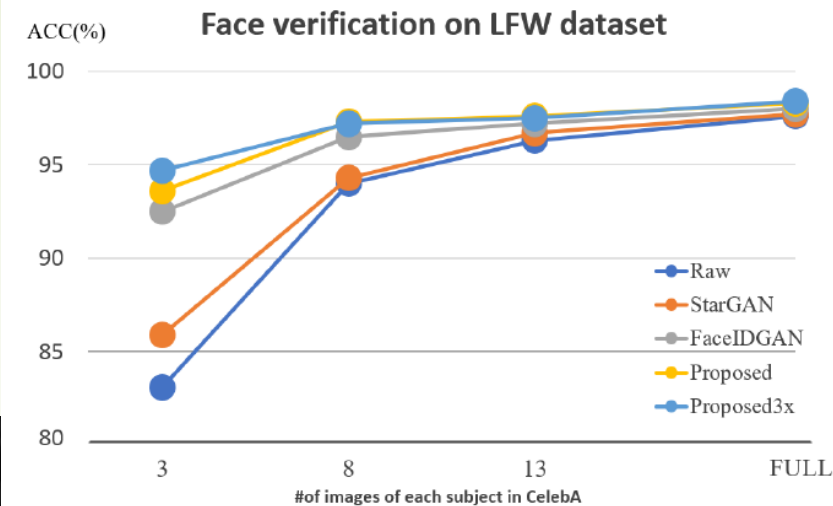
Rich Domain (open databases)

pose

Anemic
DomainDistilled
Knowledge
(training)**DotFAN**

Augmented Faces

Face Augmentation



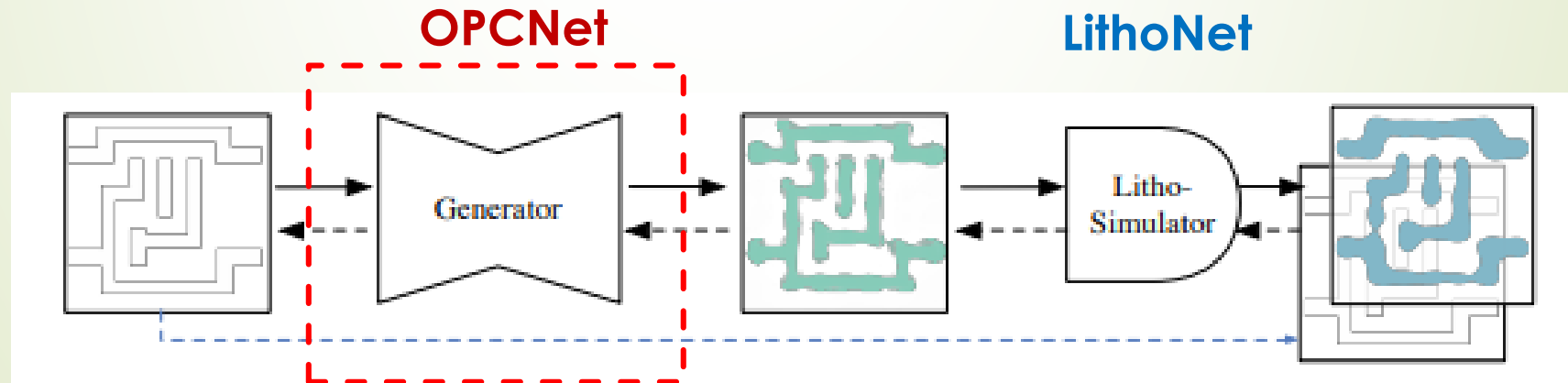
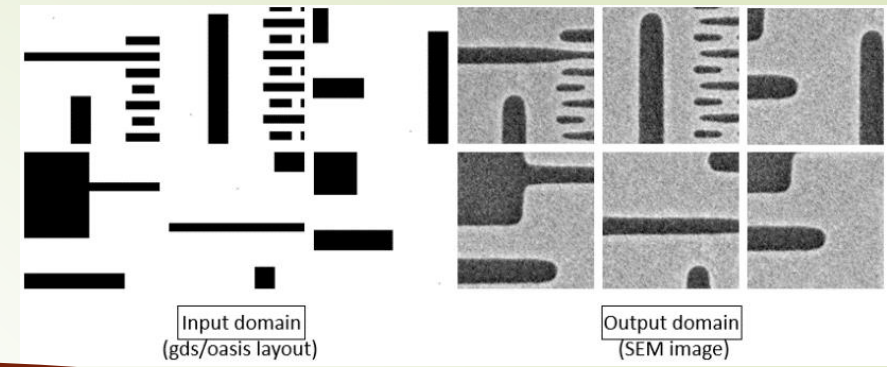
Deep Learning for IC-Fab Simulation

- We invented **LithoNet** and **OPCNet** for DfM of IC-Fab that achieve promising accuracy and achieve 200x faster than an optical model-based prediction
- **Speed:** **LithoNet** and **OPCNet** take 0.0156 and 0.0150 s to run a $2 \times 2 \mu\text{m}^2$ on NVIDIA 2080Ti GPU. Synopsys ICWB takes 34 s to run a $4 \times 1.7 \mu\text{m}^2$ patch on Intel Xeon E5-2670 CPU
- **Impact:** A **paradigm shift** in CAD tools for DfM of IC-Fab. (IC-Fab usually hires an OPC team to establish the simulation models)
- More detailed info:

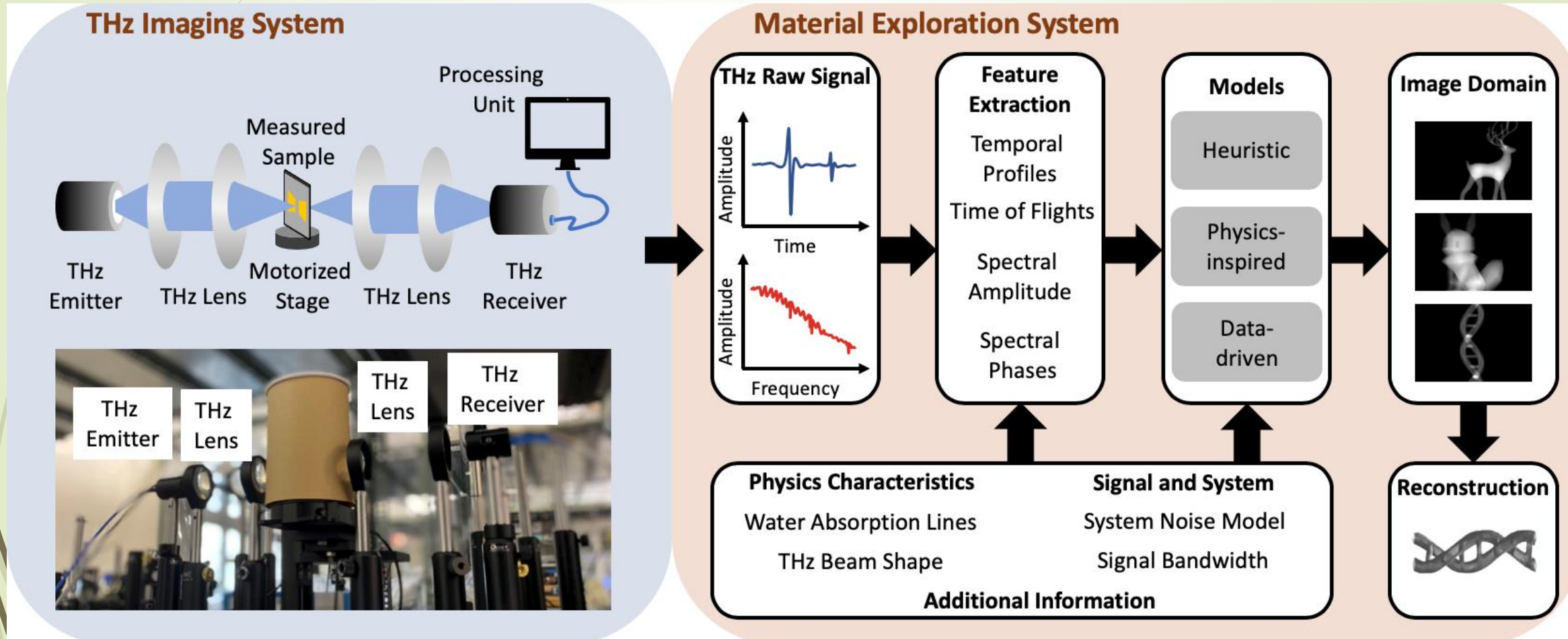
H.-C. Shao, C.-Y. Peng, J.-R. Wu, C.-W. Lin, S.-Y. Fang, P.-Y. Tsai, and Y.-H. Liu, "From IC layout to die photo: A CNN-based data-driven approach," **IEEE Trans. CAD** (May 2021), **Best paper award of VLSI/CAD 2020**

IC Fabrication Simulation

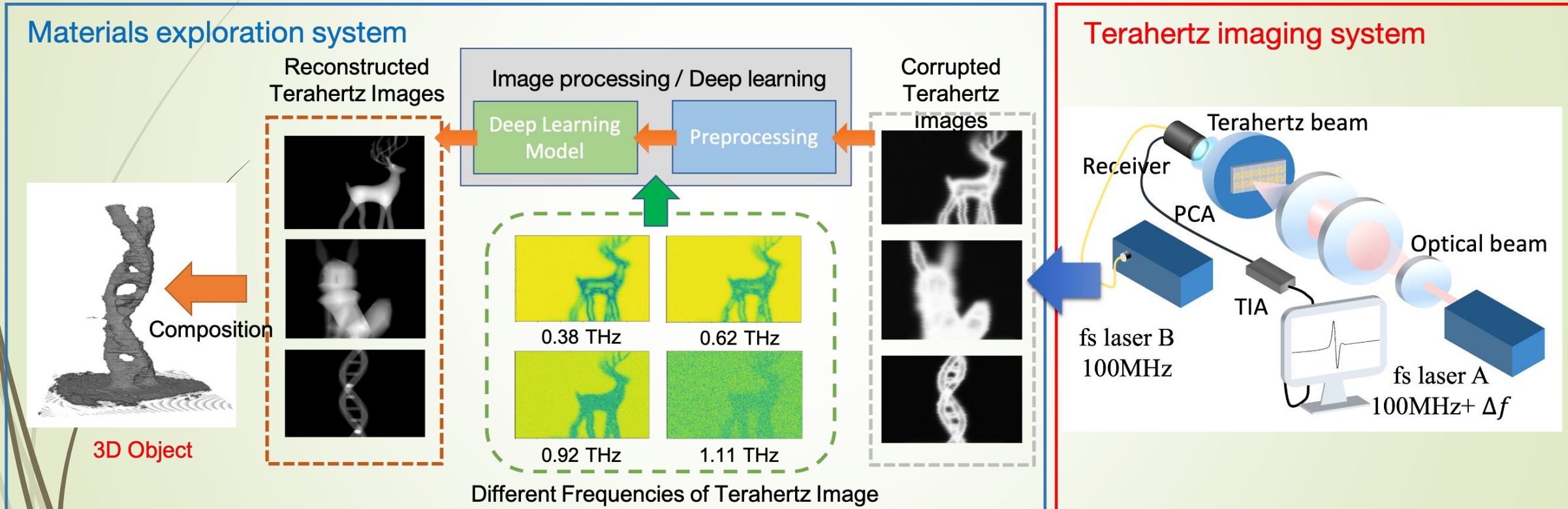
UMC



Terahertz Tomographic Imaging



Terahertz Tomographic Imaging



CV on Mobile Phone



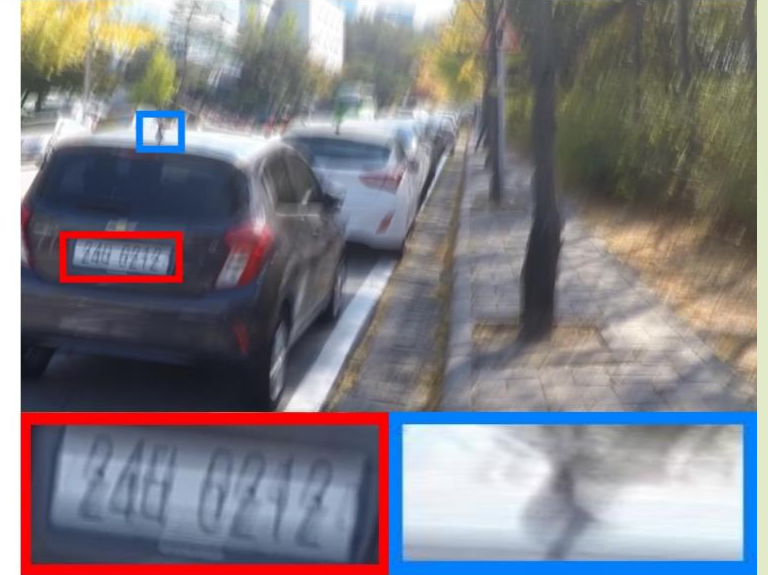
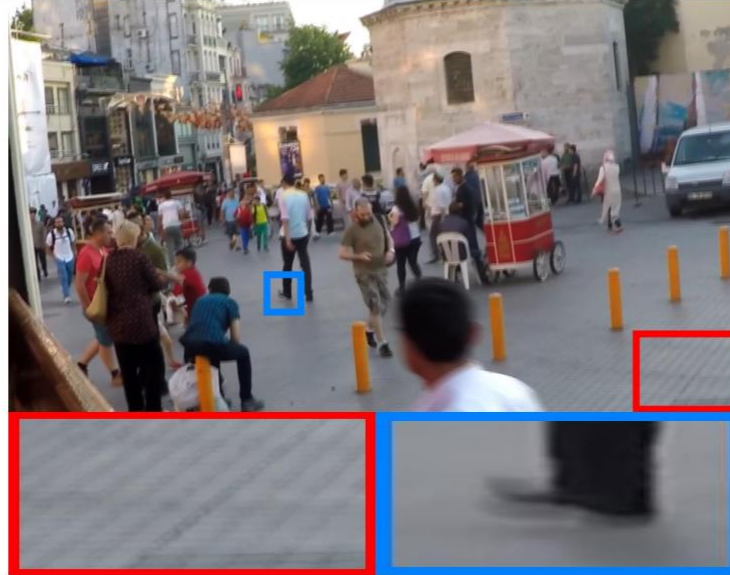
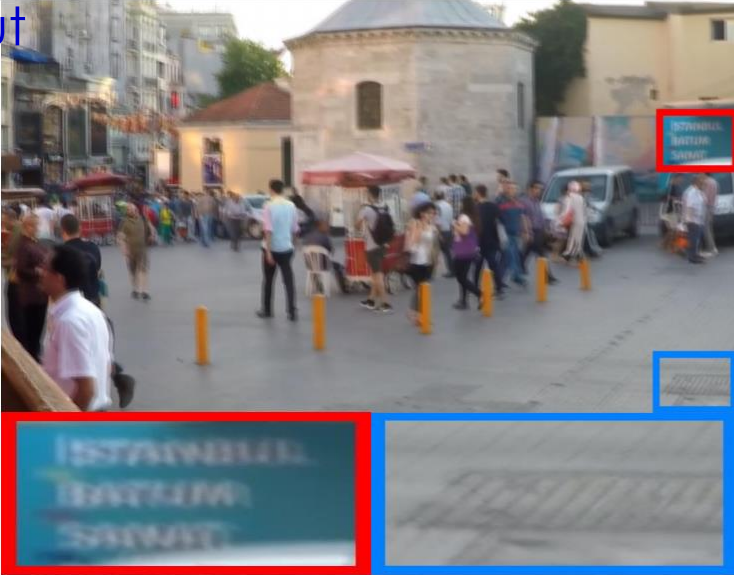
Nonhomogeneous Haze Removal (ECCV 2020)



Semantic Segmentation in Adverse Weather



Input



Output

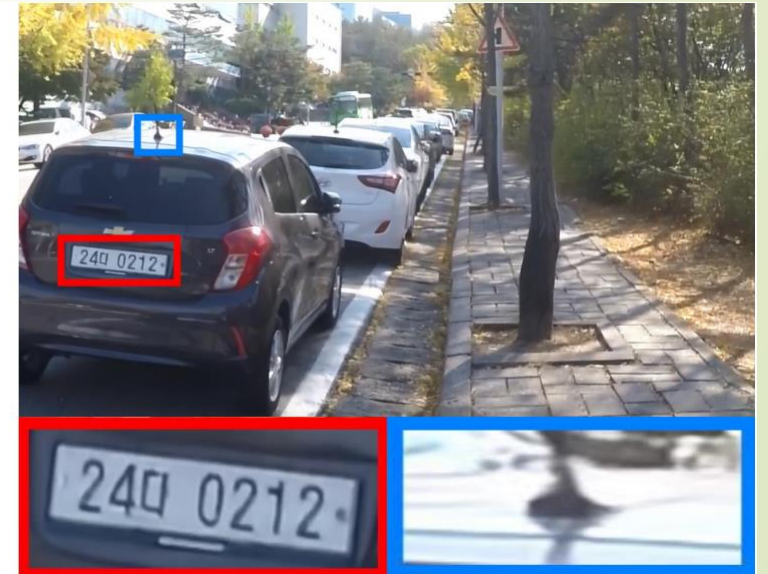
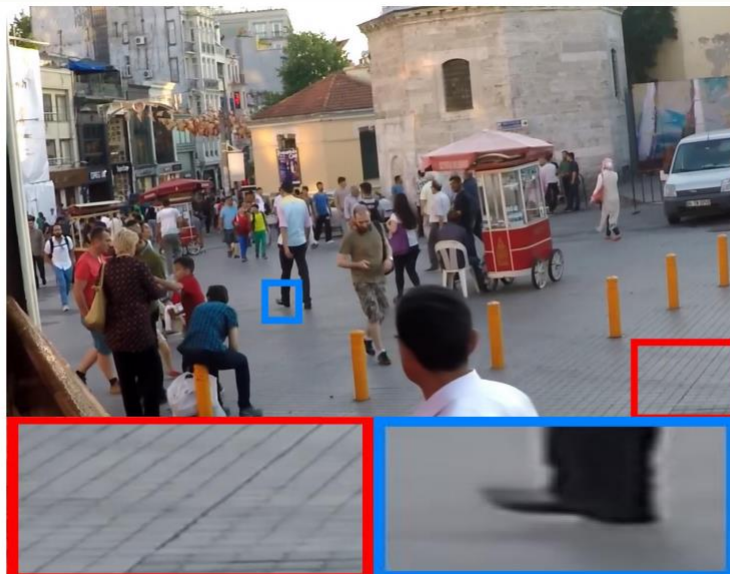
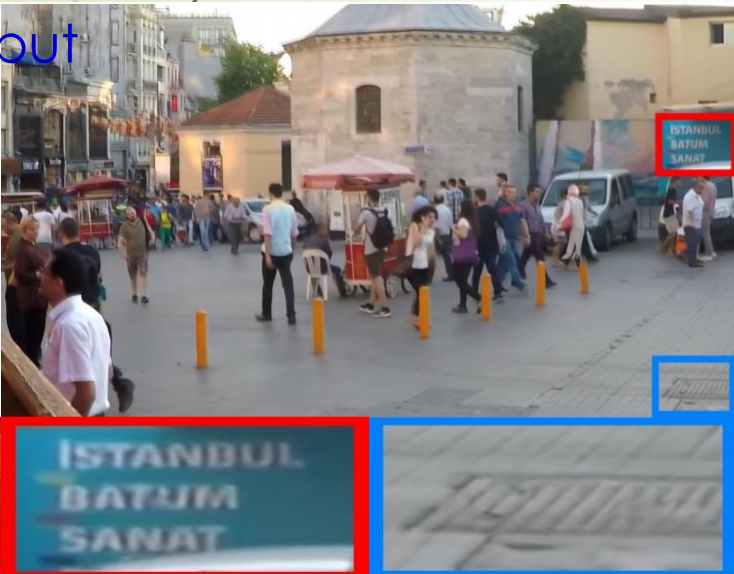
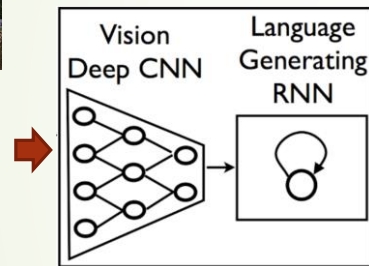


Image Co-captioning



Individual captions

A group of people sitting on a bench.
 A group of people sitting around a table.
 A group of people standing on a field with a kite.
 ...
 A group of people standing around a wooden table.



Co-captioning

The NVLab members walked down a street, visited a city park, played a kite on a lush green field, and sit around a wooden table to chat

S-T analysis
 Social analysis
 Multiview analysis
 Summarization

Image Co-segmentation & Co-captioning

Caption: Sheep A sit on a green field with three other sheep, moved to a fence, and played with sheep B



CV on Mobile Phone



Implementation based on Snapdragon 865 development kit



NEW

Snapdragon™ 865 Mobile Hardware Development Kit

The Snapdragon 865 Mobile Hardware Development Kit provides an open-frame solution for technology companies to integrate and innovate devices based on the Snapdragon 865 Mobile Platform. The Snapdragon 865 Mobile Hardware Development Kit is a feature-rich Android development platform that is designed to provide an ideal starting point for creating high-performance mobile devices and applications based on the Snapdragon 865 Mobile Platform. The kit includes the hardware, software tools and accessories needed to immediately begin your mobile development work.

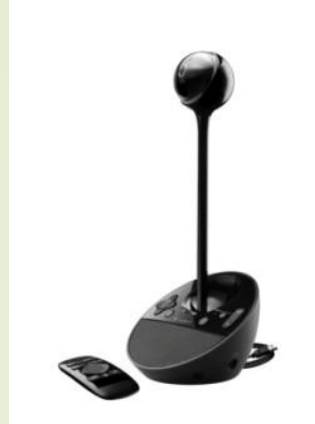
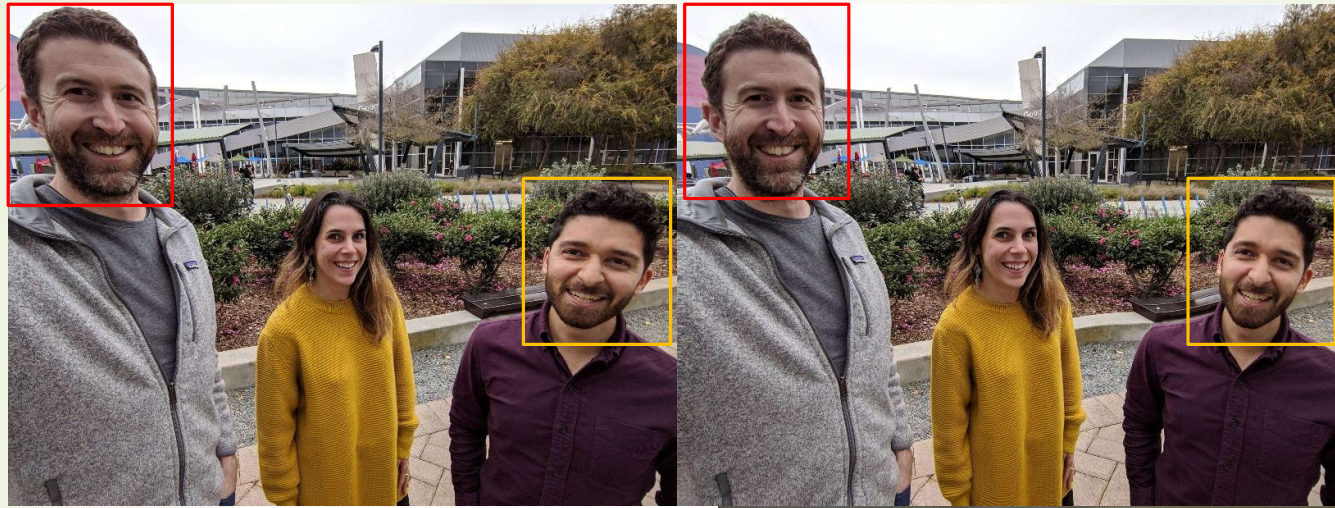
With an advanced 7-nanometer design, the Snapdragon 865 platform is engineered for innovative and intelligent on-device AI, gigapixel speed professional camera quality, desktop quality graphics, and Gigabit Class download speeds. The Snapdragon 865 mobile development platform is designed to provide original equipment manufacturers (OEMs), hardware/software vendors, developers and engineers with next generation software technology and tools to accelerate development and testing of devices.



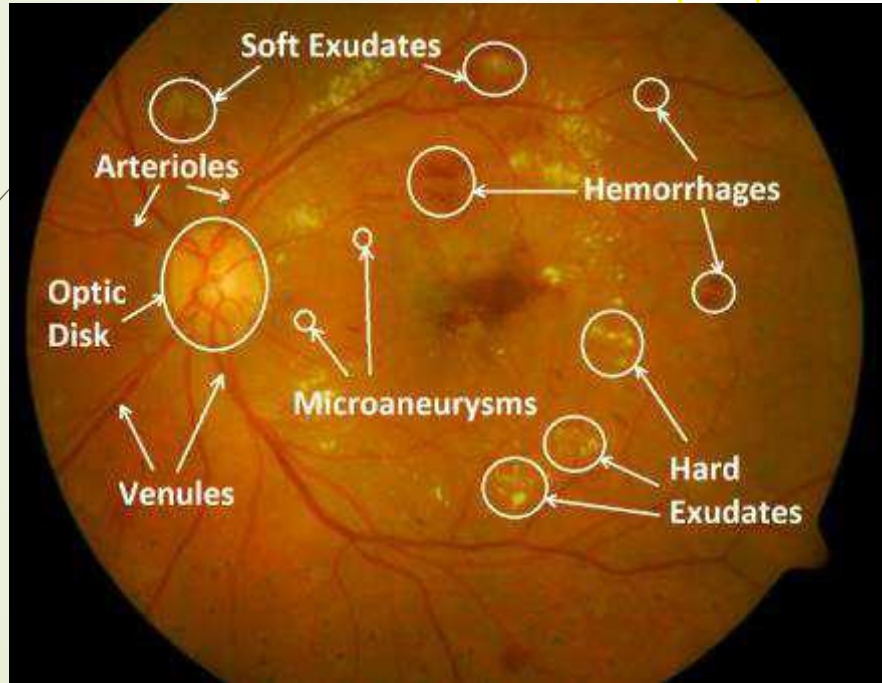
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Wide-Angle Video Conferencing

logitech®



Retina Image Analysis



target



PhD Students (Co-)Supervised

- Fu-Ren Tasi (1st year, Image Restoration on Mobile Phones)
- Jingcheng Ke (2st year, Low-shot Learning for CV Applications)
- Sadid Sahami (3nd, Graph Signal Processing for CV applications)
- Weng-Tai Su (4th year, Deep Learning & Clustering)
- Bing Li 2016 Chinese Academy of Science (with Prof. Wen Gao→ USC Postdoc)
 - Image/Video Retargeting, Depth remapping
- Chao Zhou 2014 Peking Univ. (with Prof. Zongming Guo→ Kuaishou)
 - MPEG-DASH Video Streaming
- Chih-Chung Hsu 2014 (Assistant Professor, National Cheng Kung Univ.)
 - Quality Enhancement & Assessment for Image/Video Resizing
- Chia-Ming Tsai 2013 (MediaTek)
 - Content-Based Spatio-Temporal Video Summarization
- Chi-Wen Lo 2012 (ICL/ITRI → Juiker)
 - Peer-to-Peer Video Streaming
- Chih-Ming Chen 2007 (Chunghua Telecom)
 - Wireless Video Transport
- Yuh-Ruey Lee 2007 (Assistant Professor, Asia Univ. → Software Engineer, Canada)
 - Video Transcoding

International Collaborations

- Nagoya University, Nagoya, Japan
 - **Prof. Hiroshi Murase (村瀬洋) & Ichiro Ide (井手一郎):** Multimedia Understanding
- University of Tokyo, Japan
 - **Prof. Shin'ichi Satoh (佐藤真一):** Inpainting, Person ReID
 - **Zheng Wang (王正):** Inpainting, Person ReID
- University of York, Canada
 - **Prof. Gene Cheung:** Graph Signal Processing
- Tsinghua Univ., Beijing, China (兩岸清華計畫)
 - **Profs. Jie Zhou & Jiwen Lu:** Deep-learning-based Face Processing & Identification



Hiroshi murase



Ichiro Ide



Shin'ichi Satoh



Zheng Wang



Gene Cheung



Jie Zhou



Jiwen Lu