

RIOSE Rapid-Rich Object Search Lab
博 云 搜 索 实 验 室

Enhancing Intelligent Video Analytics with Machine Learning

Dennis Sng
Deputy Director & Principal Scientist

NVIDIA AI Conference
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ROSE LAB OVERVIEW

RIOSE Rapid-Rich Object Search Lab
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2

Visual Object Categorisation

- **2D (Planar) objects:** Logos, book covers, CD covers, labels



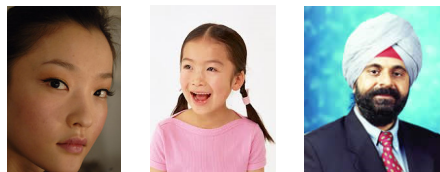
- **3D rigid objects:** Cars, hardware, product packages



- **Deformable objects:** Clothes, shoes, bags, toys



- **Faces:** Detection, Verification, Spoofing Detection, Aging Prediction

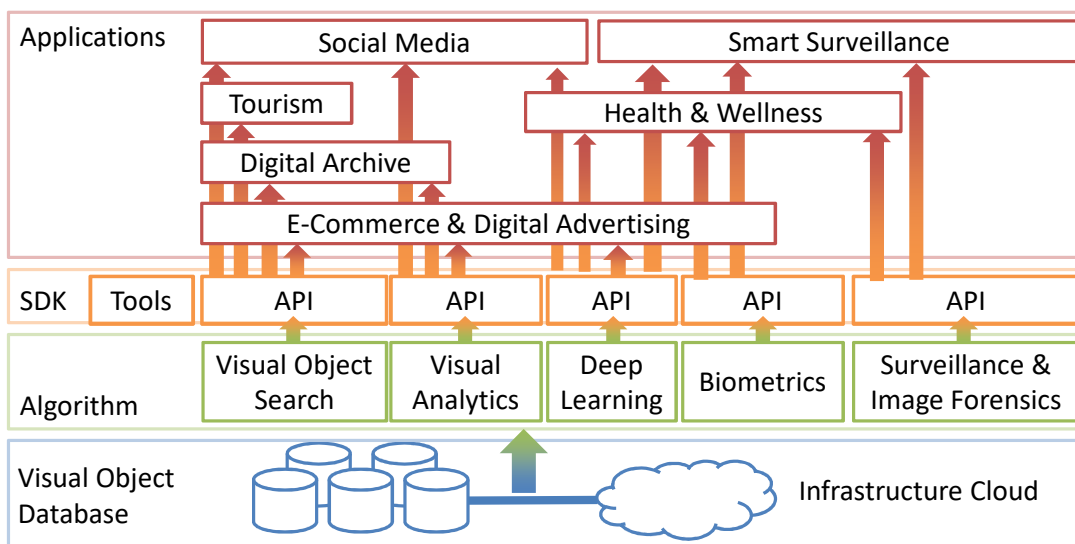


- **Landmark & Scenery**

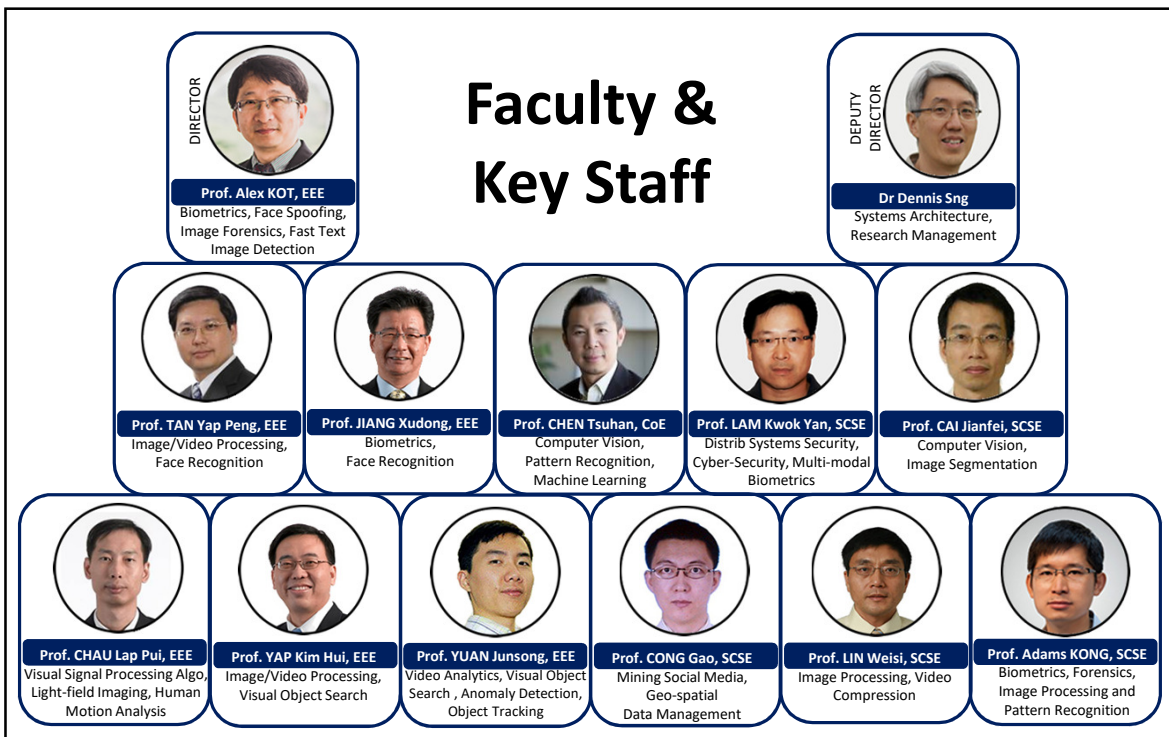
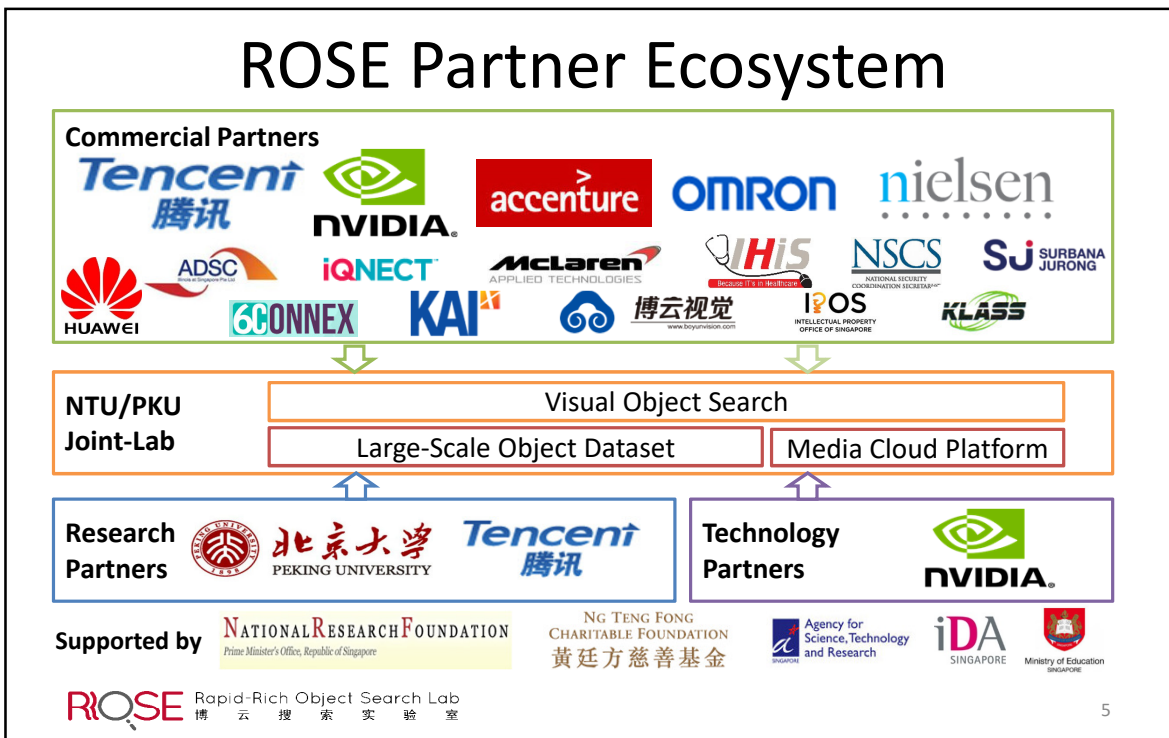


3

Solution Architecture



4

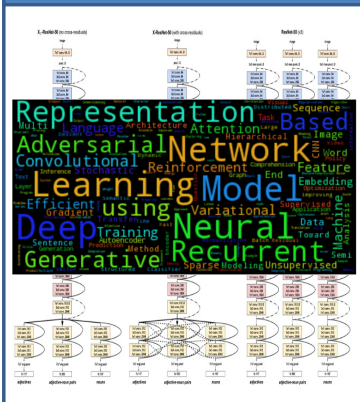


Alumni


 Dr. Rahul RAMA VARIOR Panasonic	 Prof. WANG Gang Alibaba Group	 Prof. Xu Dong THE UNIVERSITY OF SYDNEY
 Mr. YIN Jianxiong NVIDIA	 Dr. Amir SHAHROU CYBEROPTICS Technology Leadership. Global Solutions.	 Dr. LU Haifeng Alibaba Group
 Dr. CHEN Qi SAP	 Dr. YANG Gao Leica MICROSYSTEMS	 Dr. WENG Renliang Baidu 百度
 Dr. MIAO Zhenwei A*STAR Institute for Infocomm Research	 Dr. ZUO Zhen DEEPLINT 格灵深瞳	 Dr. WANG Yan JOHNS HOPKINS UNIVERSITY
 Dr. LIN Jie A*STAR Institute for Infocomm Research	 Dr. CHEN Jie 博云视觉	 Dr. Khosro BAHRA UNC SCHOOL OF MEDICINE
		 Dr. SHI Boxin PEKING UNIVERSITY
		 Dr. LI Sheng TSINGHUA UNIVERSITY
		 Dr. WANG Shiqi 香港城市大學 City University of Hong Kong
		 Dr. Anirban CHAKRABORTY

Factors Driving Deep Learning


New Algorithms & Techniques



Compute Density



Big Data Availability

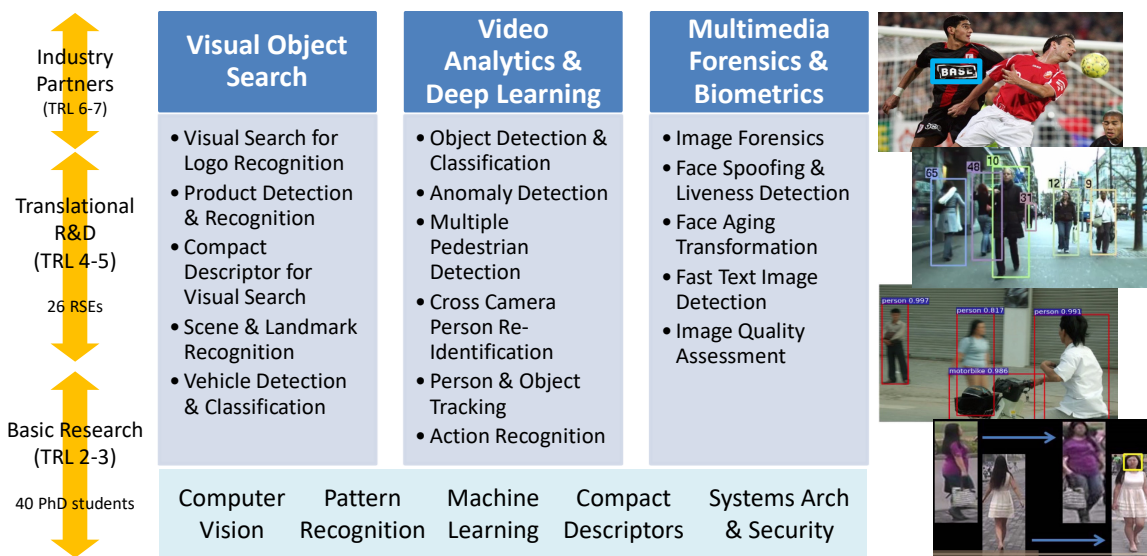


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Developing New Algorithms & Techniques

RESEARCH PROGRAMMES

Core Activities

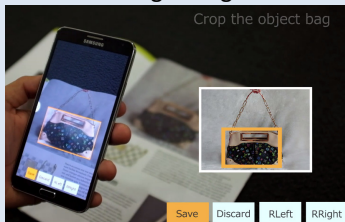


Visual Object Search

Logo Detection & Localization



Handbag Recognition



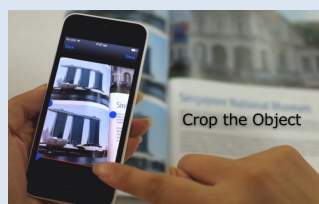
Shoe Retrieval



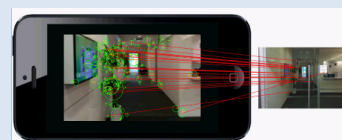
WeChat Image Search



Landmark Search



Visual Indoor Localization



Verification vs Recognition



Is this Barack Obama?
— Verification (1-to-1)



Who is this person?
— Recognition (1-to-n)

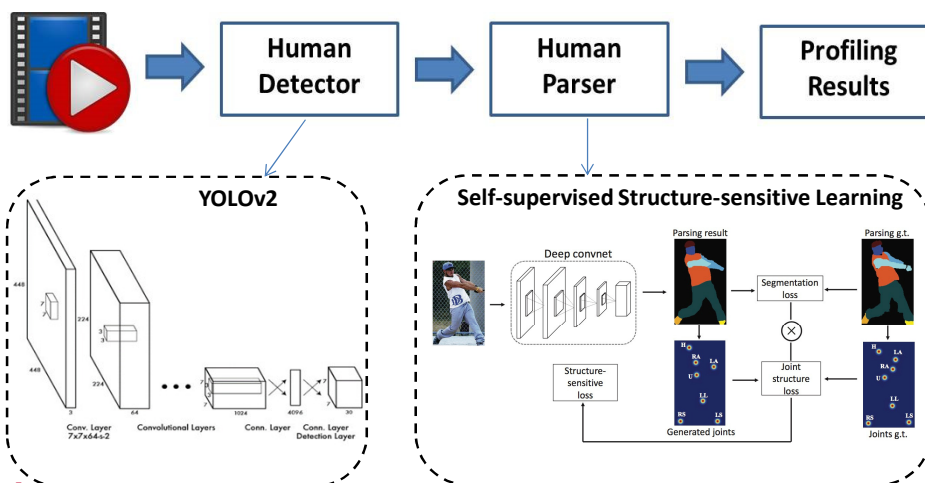
Detection



Where is PM Lee, Mr. Obama and Michelle Obama in this picture?
— Detection (localization)

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Consumer Profiling

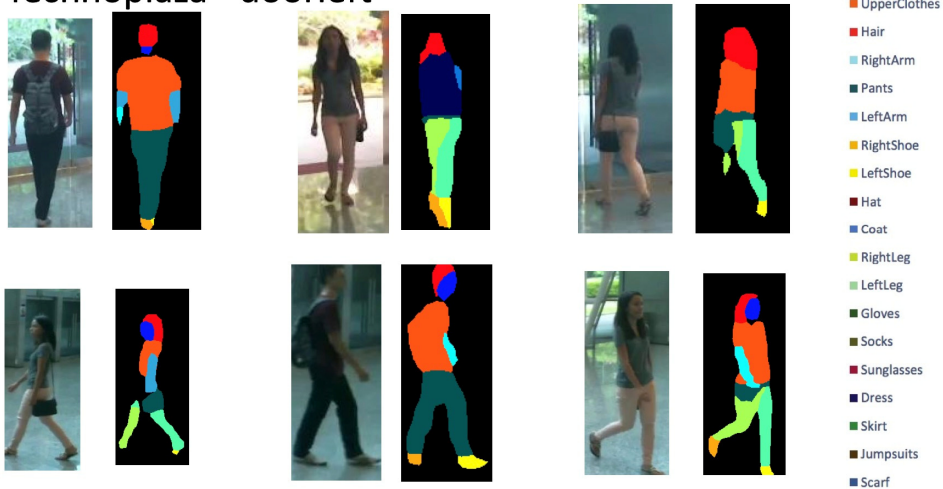


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 * courtesy of Redmon et al. 实验室

* Courtesy of Gong et al.

Consumer Profiling: Sample Parsing Results

• Technoplaza - doorleft



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Consumer Profiling: Sample Results



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Video Analytics & Deep Learning



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20

Cross Camera Human Re-Identification

Algorithm aims to recognize an individual

- Same or Different Camera
- Overlapping or Non-Overlapping

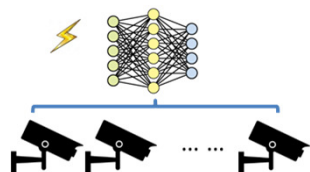
Example Forensic Applications

- Searching for a suspect
- Evidence gathering
- Etc

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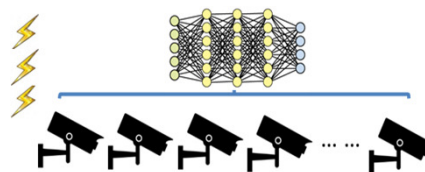


Cross Camera Human Re-Identification



Front-end API

- 7 layer Siamese CNN
- Light weight and fast, but less accurate.
- Serves as a single camera-based fast scanning, filtering out obviously irrelevant person objects.
- Roughly positive results can be found in top-25 ranking in most of time.

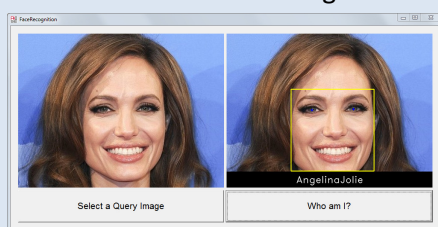


Back-end API

- 50 layer CNN
- Have more computation power and more accurate.
- Requires more computation resources.
- Roughly positive results can be found in top-10 ranking in 80% of time.

Multimedia Forensics & Biometrics

Face Detection & Recognition



Face Spoofing Detection



Face Ageing

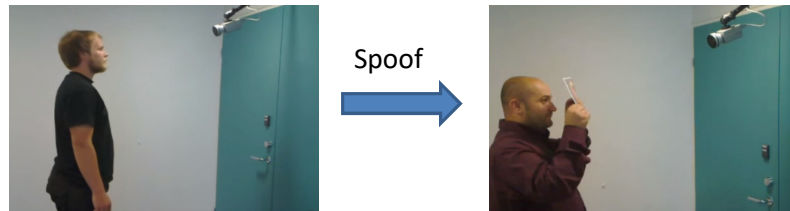


Fast Text Image Detection



Face Spoofing Attack Scenarios

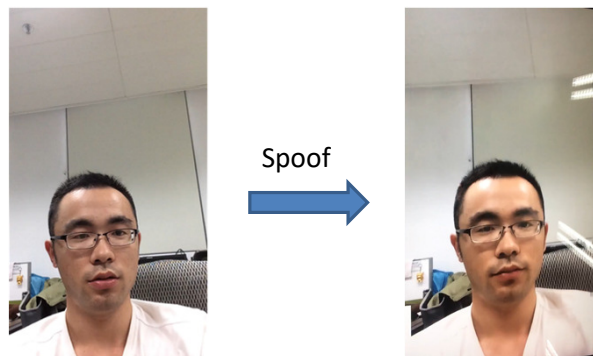
- Door Controlled Access



- Camera model & environment are known in advance.
- Spoofing detection can be easily done with deep learning or other computer vision techniques.

Face Spoofing Attack Scenarios

- Mobile Unlock/Payment



- Camera model, environment are not known in advance.
- Existing Algorithms can suffer from over-fitting problem.

Big Data Availability

LARGE-SCALE DATASETS

ROSE Shareable Datasets

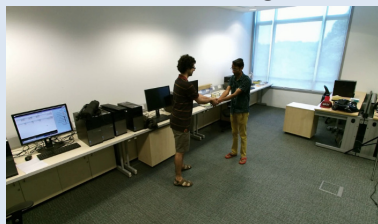
Recaptured Image



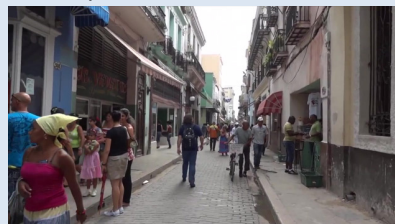
Video Object Instance



RGB+D Action Recognition



Multiple Pedestrian Detection



ROSE Large scale RGB+D Action Recognition Dataset

- 56880 Video Samples
- More than 4M frames
- 60 Classes
- 80 Views
- 40 Different Human Subjects
- Kinect V2 Sensor



Amir Shahroudy, Jun Liu, Tian-Tsong Ng, and Gang Wang, "NTU RGB+D: A Large Scale Dataset for 3D Human Activity Analysis", IEEE Conference on Computer Vision and Pattern Recognition (CVPR) 2016

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33

ROSE RGB+D Action Recognition Dataset: Comparison with other datasets

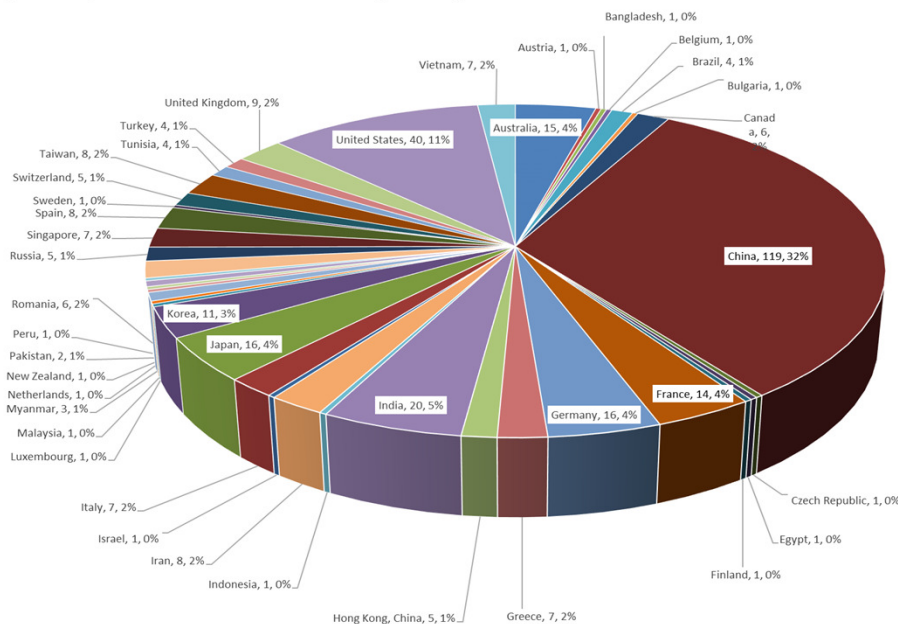
Datasets	Samples	Classes	Subjects	Views	Sensor	Modalities	Year
MSR-Action3D [4]	567	20	10	1	Kinect v1	D+3DJoins	2010
CAD-60 [12]	60	12	4	-	Kinect v1	RGB+D+3DJoins	2011
RGBD-HuDaAct [7]	1189	13	30	1	Kinect v1	RGB+D	2011
MSRDailyActivity3D [14]	320	16	10	1	Kinect v1	RGB+D+3DJoins	2012
CAD-120 [3]	120	10+10	4	-	Kinect v1	RGB+D+3DJoins	2013
3D Action Pairs [8]	360	12	10	1	Kinect v1	RGB+D+3DJoins	2013
Multiview 3D Event [19]	3815	8	8	3	Kinect v1	RGB+D+3DJoins	2013
Online RGBD Action [21]	336	7	24	1	Kinect v1	RGB+D+3DJoins	2014
Northwestern-UCLA [16]	1475	10	10	3	Kinect v1	RGB+D+3DJoins	2014
UWA3D Multiview [10]	~900	30	10	1	Kinect v1	RGB+D+3DJoins	2014
Office Activity [18]	1180	20	10	3	Kinect v1	RGB+D	2014
UTD-MHAD [1]	861	27	8	1	Kinect v1+WIS	RGB+D+3DJoins+ID	2015
UWA3D Multiview II [9]	1075	30	10	5	Kinect v1	RGB+D+3DJoins	2015
Our dataset	56880	60	40	80	Kinect v2	RGB+D+IR+3DJoins	2016

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34

RGB+D Action Recognition Dataset

(372 Requests from 41 countries - Sept 2017)



Industry

- Baidu
- Facebook AI Research
- HikVision
- IBM Research Tokyo
- Intel Labs China
- Microsoft Research Asia
- Mercedes Benz R&D India
- Mitsubishi Electric
- Panasonic R&D S'pore
- United Technologies

Research

- Chinese Academy of Sciences
- ETH Zurich
- INRIA

Academia

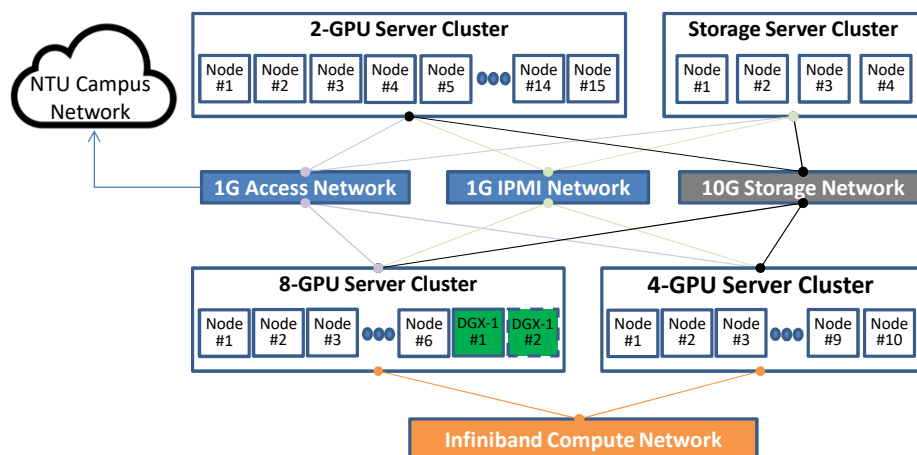
- UC Berkeley
- CUHK
- NUS
- Stanford U
- Tsinghua U
- TUM
- Zhejiang U

Computing Density:

Training Platform for Deep Learning

GPU COMPUTING ARCHITECTURE

ROSE Network Architecture Overview



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Thank You

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