Global Harmonization Working Party
GHWP Towards Medical Device Harmonization

AI-Powered Innovations in Medical Devices and Software: A Journey through Progress and Trends

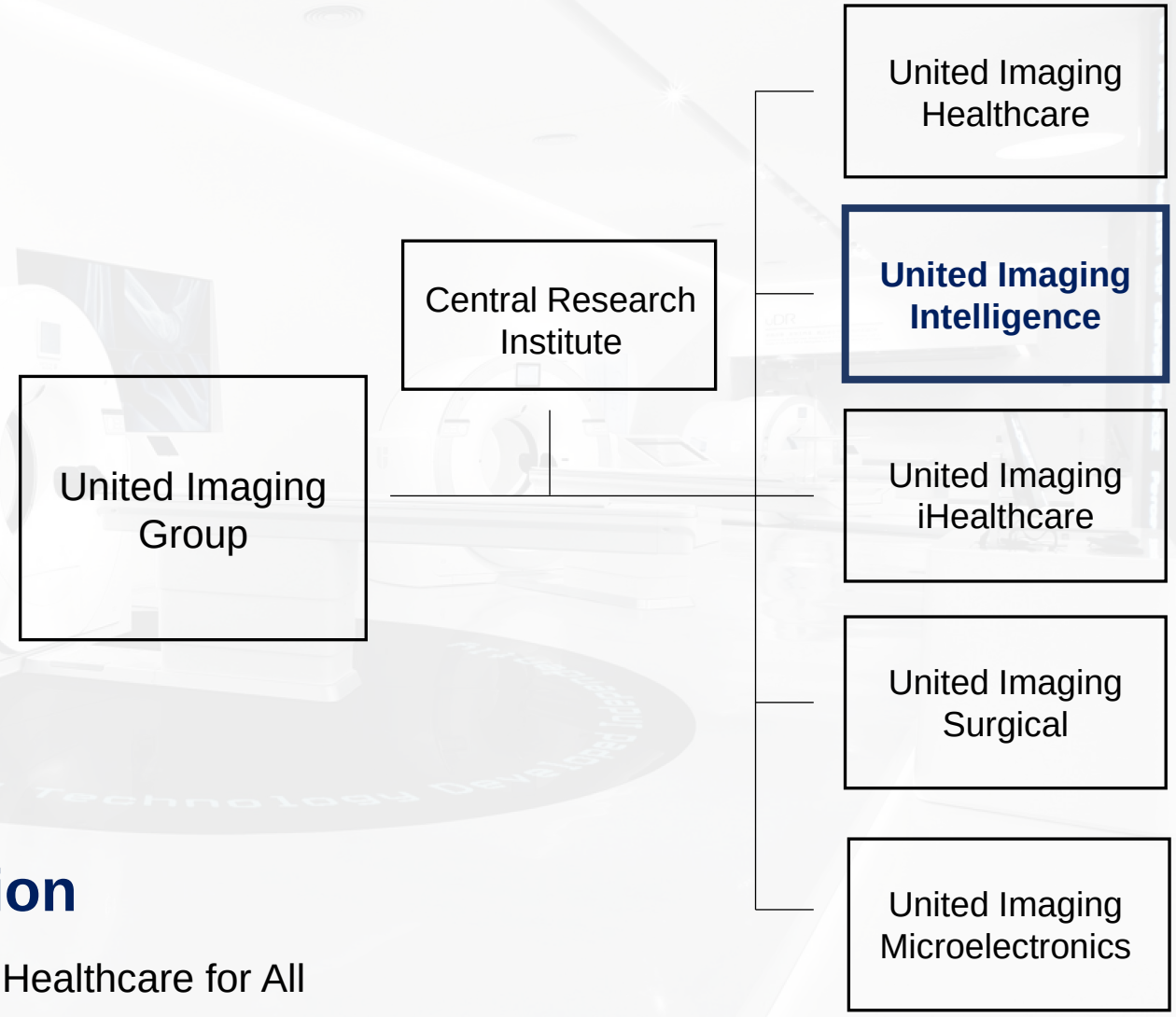
Presenter: Yaozong Gao

Date: 2023.12.27

Shanghai United Imaging Intelligence Co., Ltd.

United Imaging Intelligence

United Imaging Intelligence Co., Ltd. (UII), headquartered in Shanghai, is a subsidiary of United Imaging Healthcare Technology Group Co., Ltd. (United Imaging Group). Since its founding in 2017, UII has been delivering various artificial intelligence (AI) solutions to medicine and transforming the way healthcare is delivered. UII has become a prominent international medical AI company that enables smart equipment, supports biomedical research, and provides total solutions to clinical workflow from screening and diagnosis to treatment and follow-up assessment.



Our Vision

Leading Medical AI Innovation

Our Mission

To Bring Equal Healthcare for All

Our Portfolio

With AI, we bring -

Unprecedented capabilities and ease-of-use to medical equipment

Empowering Medical Equipment

Higher accuracy and efficiency to clinical workflow

Empowering Clinical Workflow

New opportunities to scientific research and collaboration

Empowering Scientific Research

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Bringing AI to All Medical Equipment

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uAI

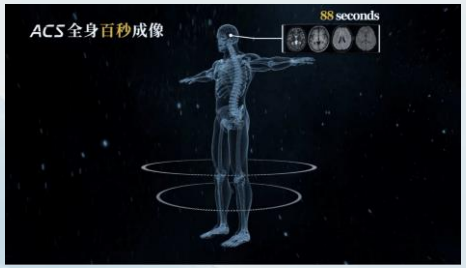
Faster workflow **Better** images
Higher throughput **Easier** to operate **Safer** for patients

Enables Medical Equipment

AI-Enabled Intelligent Scanning

Fast MRI Imaging

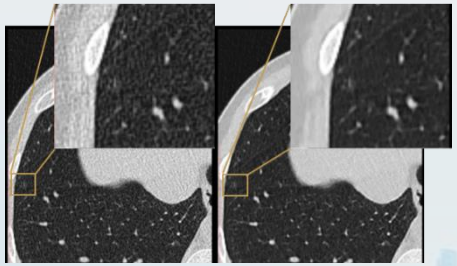
- ACS High-speed MRI scanning
- Full coverage
- Average scanning time: <100 seconds
- Average 70-80% time saving



High-Speed Intelligent Scanning

Low-Dose CT Imaging

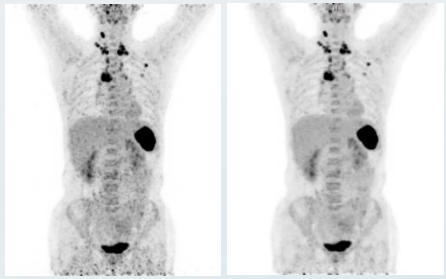
- Low-dose lossless CT imaging
- Up to 80% reduction in radiation dose for CT scans
- Increasing low contrast resolution by nearly 160%



Traditional Imaging | AI Imaging

PET Scan Noise Reduction

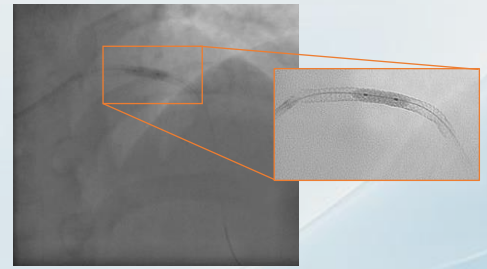
- Reducing PET image noise
- Improving PET image quality
- Increasing image signal-to-noise ratio by 42%



Traditional Reconstruction | AI-Assisted Reconstruction

High-Definition DSA Imaging

- Accurate coronary stent visualization
- Real-time high-definition visualization



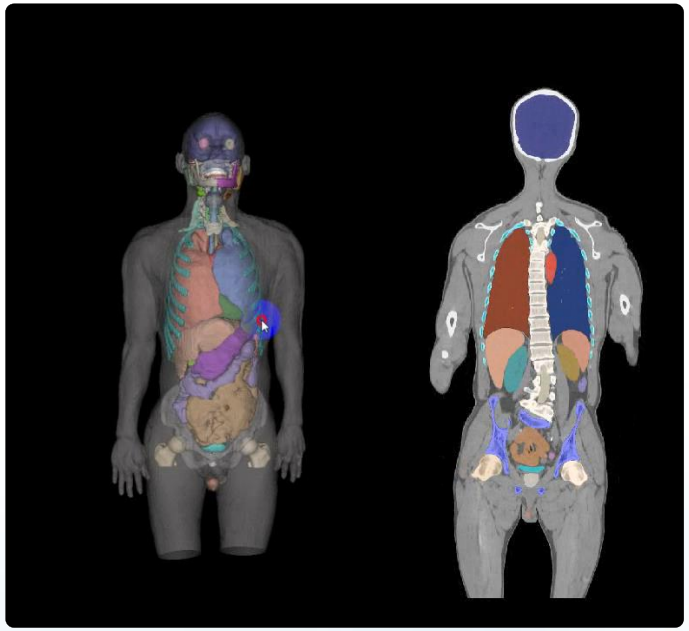
Original Image | AI-Assisted Stent Visualization

Enables Medical Equipment

All-in-One Radiation Therapy

Intelligent Organ and Target Tumor Delineation

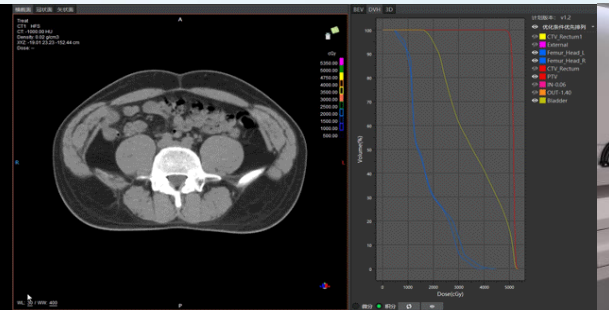
- Fully automatic segmentation of 81 major-at-risk organs and target areas
- Based on real-time CT images
- Delineating organs within 1 second, e.g., kidney, heart and brain tissues
- Over 95% of delineation accuracy



ALL IN ONE SOLUTION

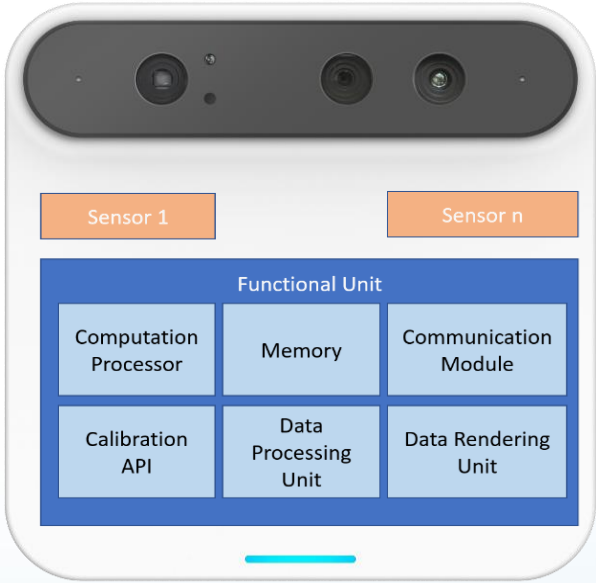
- Innovation in deep fusion: intelligent integration of diagnostic CT into end-to-end workflow
- Achieving a groundbreaking reduction in entire workflow from 23 days to 23 minutes, thereby preventing patients from having repeated hospital visits




uVision Camera

RSNA, Chicago, USA, December 2019

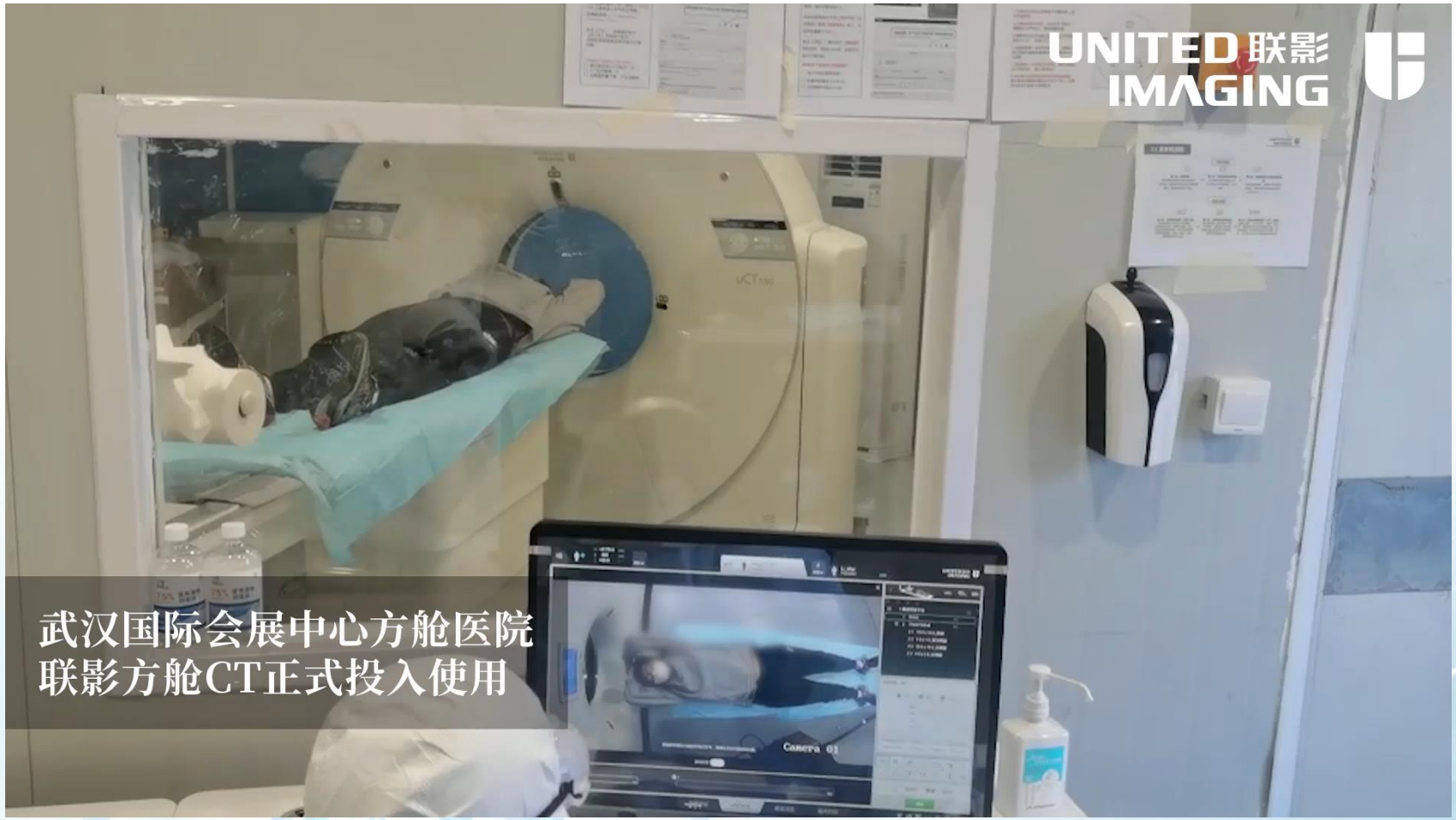


- Real-time 360° full-body dynamic capture
- Automatic generation of 3D models
- Enabling various medical imaging equipment to achieve automatic positioning, alignment, bed adjustment, and parameter settings, thus enabling one-touch intelligent scanning

uVision Camera

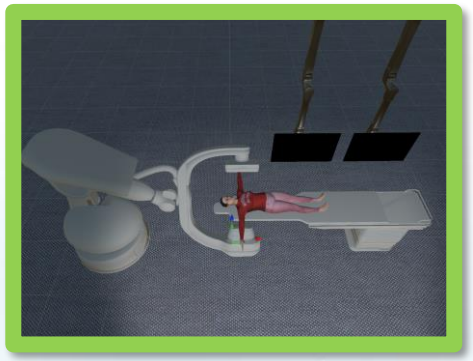
RSNA, Chicago, USA, December 2019

Wuhan, China, February 2020

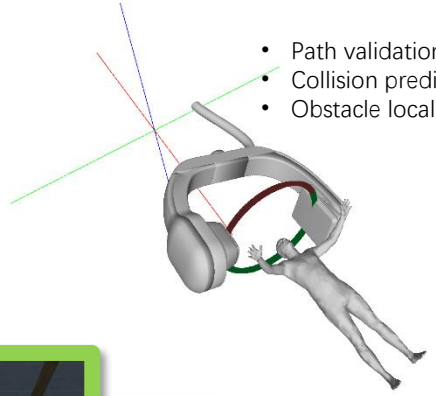


uVision Camera

Next-Generation Applications of Digital Twins



Integrated real-time visualization and simulation



- Path validation
- Collision prediction
- Obstacle localization

- Robot navigation
- Guidance
- Procedure monitoring
- Safety assurance
- Online update/correction of surgery plan

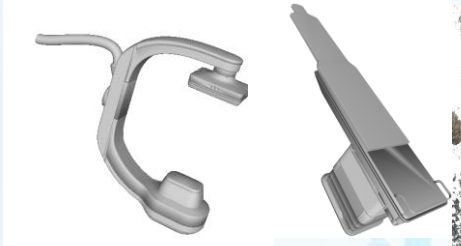
- Remote surgery
- Global collaborations
- Automation

Real-Time Actuation

Real-Time Modeling

Multiple visual sensors

Surgical Room



Device Engineering Model

Environment Model

Patient Model

Our Portfolio

With AI, we bring -

Unprecedented capabilities and ease-of-use to medical equipment

Higher accuracy and efficiency to clinical workflow

New opportunities to scientific research and collaboration

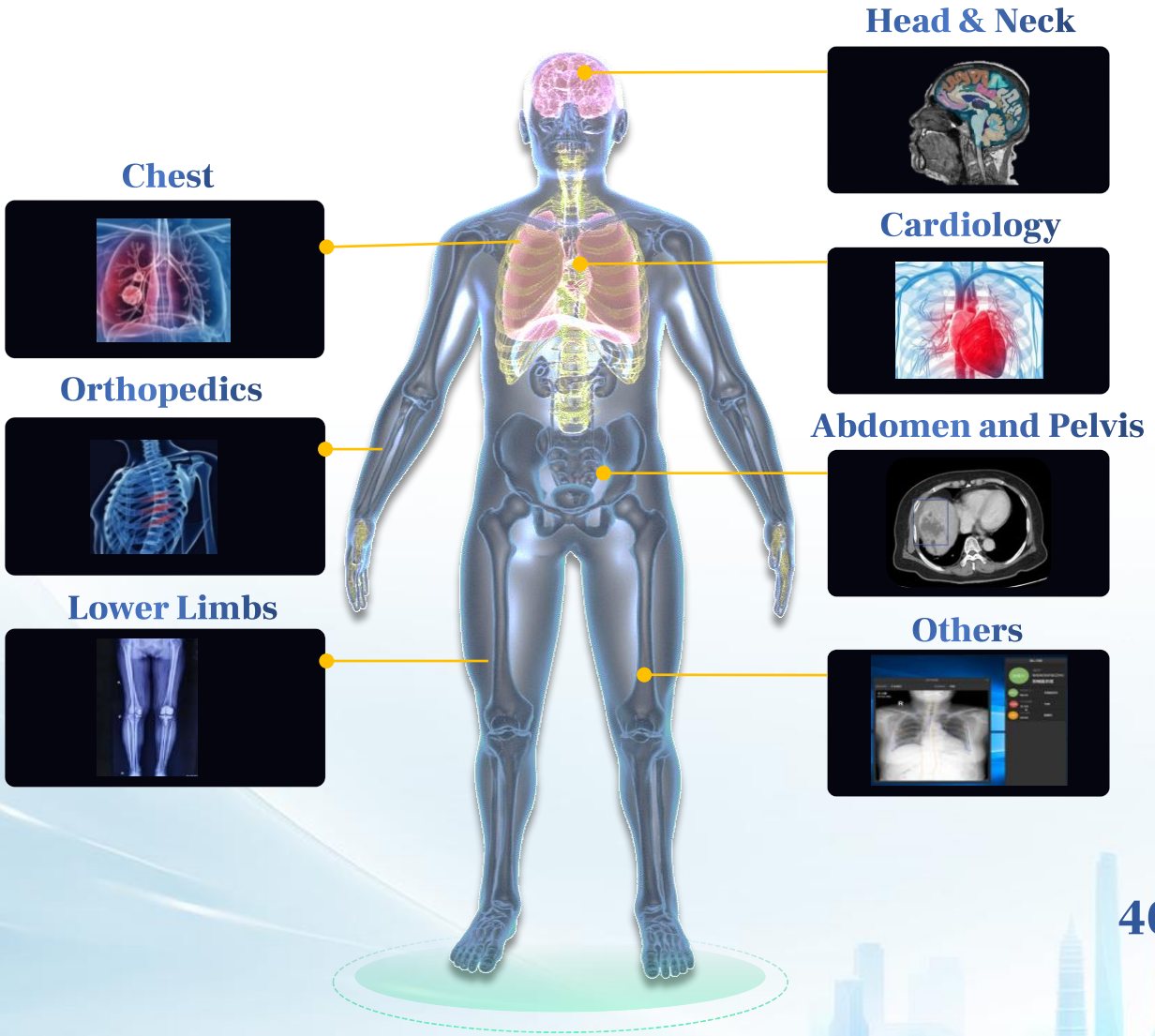
Empowering Medical Equipment

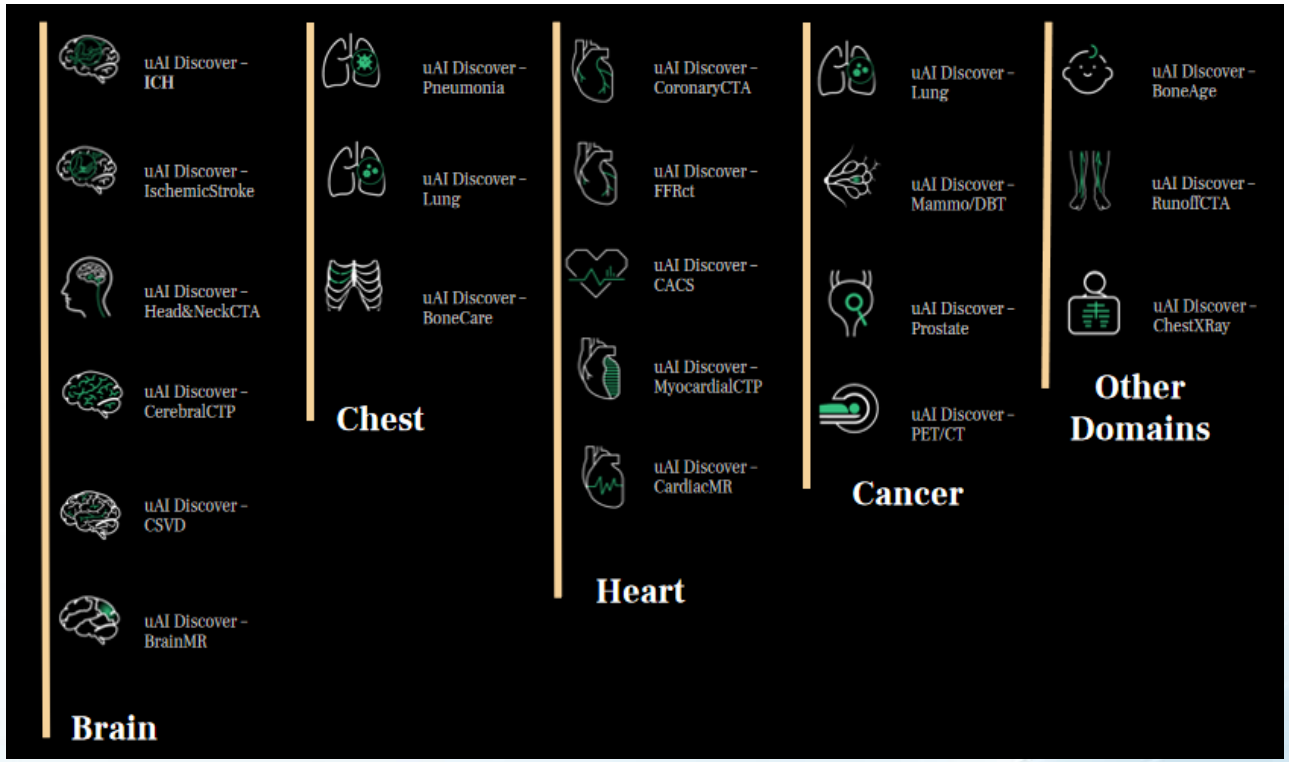
Empowering Clinical Workflow

Empowering Scientific Research

How many AI applications have been developed on uAI Clinical Portal?

UNITED IMAGING | United Imaging Intelligence





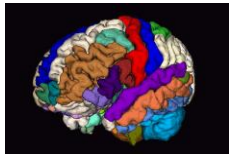
40+ AI solutions deployed in more than 1,700+ sites

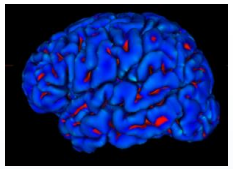
AI-Assisted Neurological Solutions

We provide world-class AI solutions to target challenges on brain science, such as degenerative diseases.

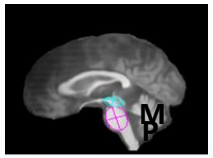
We provide the most comprehensive solution for stroke, empowering different stages of clinical workflow.

Brain Science





uAI Discover Brain



uAI Discover CSVD

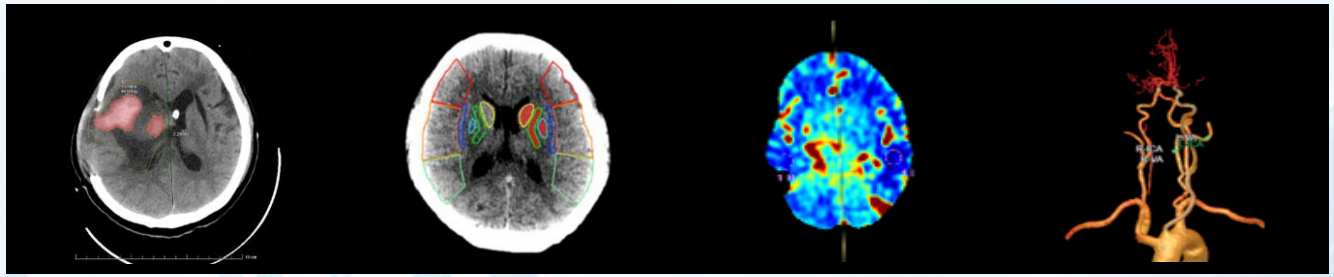
MRI

uAI Discover
Brain Metastases

Stroke Management

CT

AI-Assisted Solution for Stroke



uAI Discover ICH

uAI Discover
Ischemic Stroke

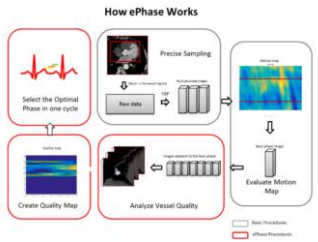
uAI Discover
Cerebral CTP

uAI Discover
Head & Neck CTA

AI-Assisted Cardiovascular Solutions

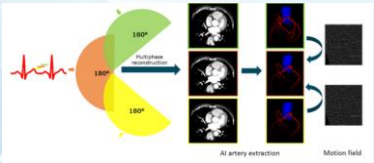
Imaging

1. ePhase



Dynamically capturing the optimal coronary imaging phase for each cardiac cycle

2. CardioCapture



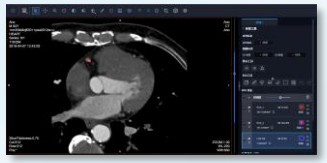
Automatically extract and track coronary tree branches using deep learning, which can significantly reduce coronary motion artifacts

Screening

1. Non-gated low-dose chest CT scan

Non-gated coronary artery calcium score (CACS)

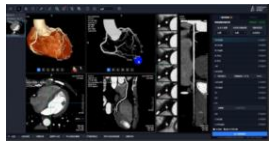
2. Dedicated ECG-gated cardiac CT scan



Gated coronary artery calcium score (CACS)

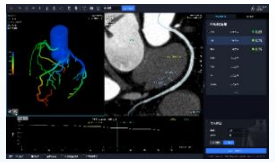
Diagnosis

1. Anatomic stenosis estimation



CTA coronary

2. Hemodynamic analysis



FFRct

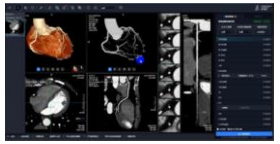
3. Ventricular function assessment

Cardiac MRI

Emergency

Chest pain center emergency scenario

1. Acute coronary syndrome



CTA coronary

2. Pulmonary artery embolism

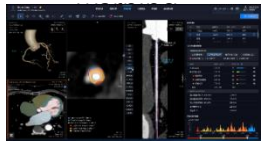
CTA pulmonary artery

3. Aortic dissection

CTA aorta

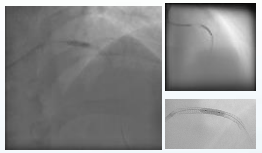
Follow-up

1. Plaque quantification and vulnerable plaque



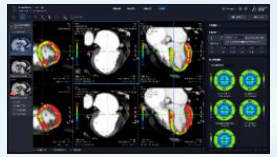
Plaque analysis

2. AI empowering DSA



Stent enhancement display

3. Evaluation of postoperative effects of PCI



CT myocardial perfusion

Research

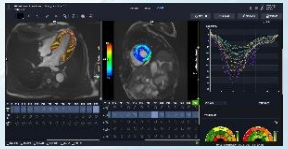
1. Pericoronary FAI

CTA coronary

2. Plaque composition quantitative analysis

Plaque analysis

3. Myocardial strain analysis



Cardiac MR

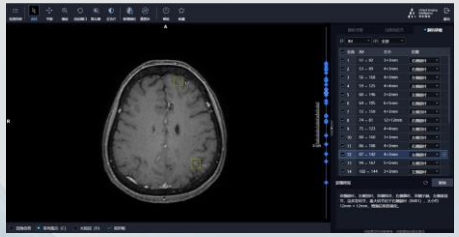
AI-Assisted Oncological Solutions

AI-assisted screening, diagnosis and staging for multiple major cancers and metastases

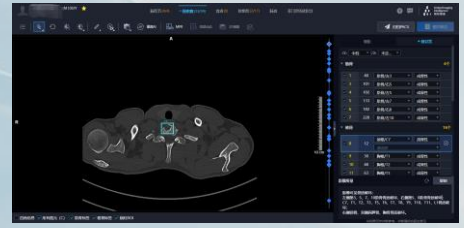
Metastasis

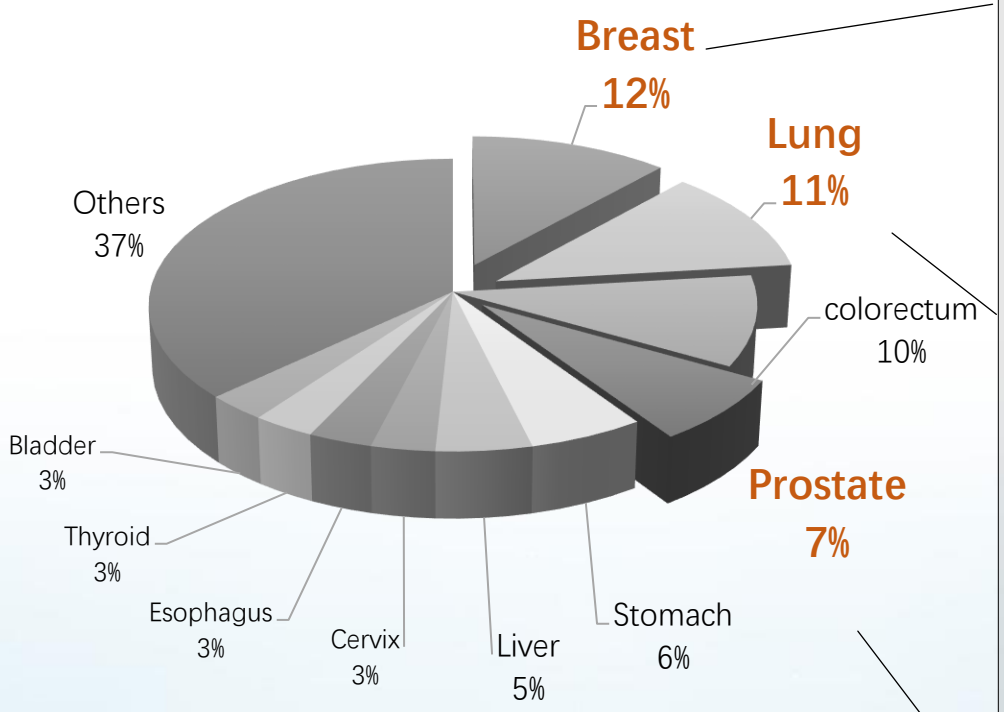
PET/CT Whole-Body Abnormal Uptake Detection

MRI Brain Metastasis Detection



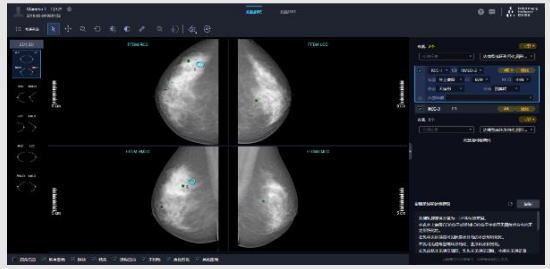
CT Bone Metastasis Detection



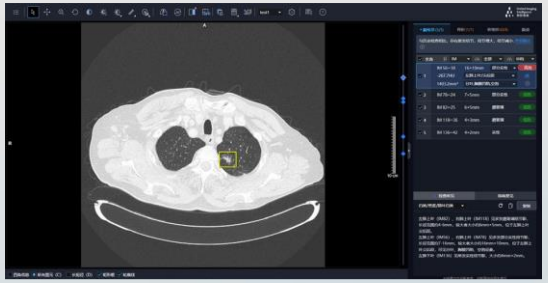


2020 Global Cancer Incidence

FFDM/DBT Breast Cancer Detection



CT Lung Nodule Detection and Follow-up



MRI Prostate Cancer Diagnosis

Example: Full-stack Management of Lung Nodules

Patient-centric and intelligent management of lung nodules by AI

Risk Assessment

Population education and **online assessment** of lung cancer risk

High-risk population identification and online appointment for further diagnosis.

AI-Assisted Screening

Radiology Department

AI+doctor VS **doctor alone**: sensitivity +**33%**, AUC +**0.19**, reading time reduced by **26%**

NMPA (China), CE approved

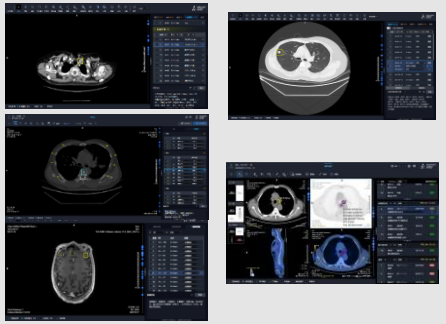
AI detection and analysis of lung nodules

AI

Deployed in hospitals, cloud, and mobile CT units.

AI-Assisted Diagnosis

Respiratory Medicine / Radiology / MDT



Benign-Malignant Diagnosis

Multi-center: West China Hospital, Ruijin Hospital, Changzheng Hospital

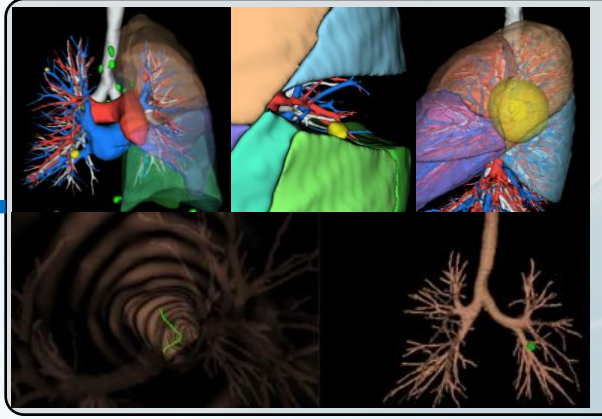
AUC: **91%**

Cancer Staging: lymph nodes, lung, brain and bone metastasis, PET/CT

Follow-up plan development, patient management and automatic reminder

AI follow-up analysis: AI nodule matching and multi-dimensional comparative analysis

AI-Powered Follow-up Management



Surgery Planning Tools: sub-segmental analysis, resection simulation, edge expansion, and virtual bronchoscopy.

Multi-terminal Deployment: PC, mobile phone and tablet computer.

Personalized Presurgical Planning

Thoracic Surgery

Baseline

Follow-up

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AI for Science - uAI Research Portal

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Centralized Data Repository and Project Management

Multi-modal Data Collection

- Localized server deployment
- Seamless integration with in-house data systems
- Multiple data sources import

Unified Project Management

- Projects and data permission management
- Multi-center data pool establishment
- PHI identification and protection

Clinical Model Construction and Validation

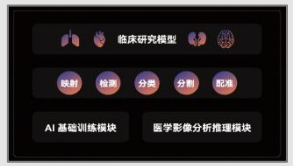
Covering biomedical research from diagnosis, assessment, to prognosis, without programming skills

Radiomics Modeling - Biomarkers

ML | Small Samples

AI Personalized Models

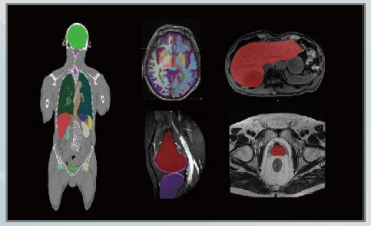
DL | Big Data



Smart Annotation for Medical Images

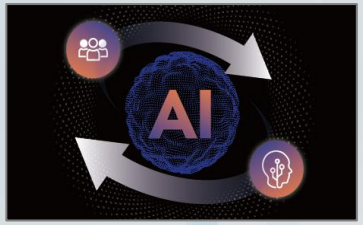
150+ DL-based automatic segmentation models

Batch automatic segmentation

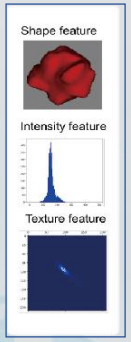


Efficient interactive segmentation tools

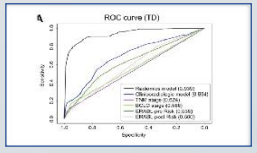
Online learning algorithm makes annotation more accurate



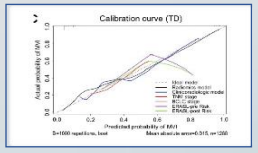
Built-in Biostatistical Tools



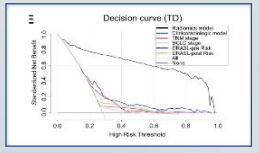
Radiomics feature visualization



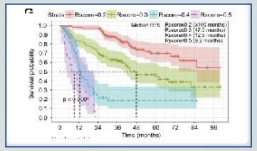
ROC curve



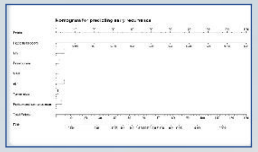
Calbiration curve



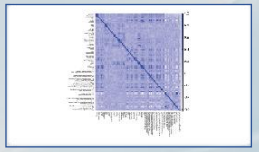
Decision curve analysis



Kaplan-Meier curve



Nomogram



Heatmap

Trends: Medical Foundation Models

Medical Image Foundation Model

Foundation models trained on large medical image data from various diseases have the capability to quickly adapt themselves to image data from new diseases.

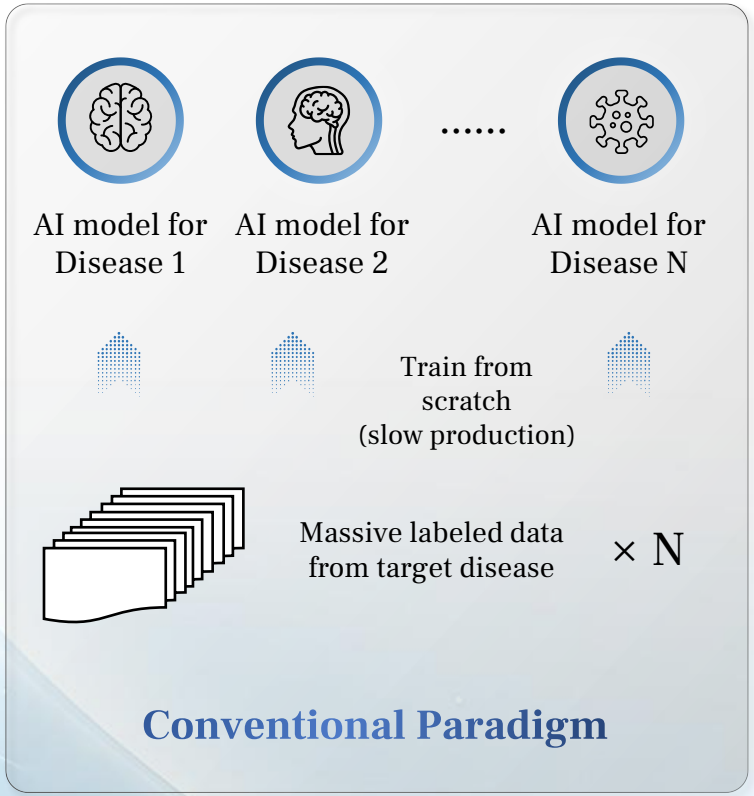
Medical Language Foundation Model

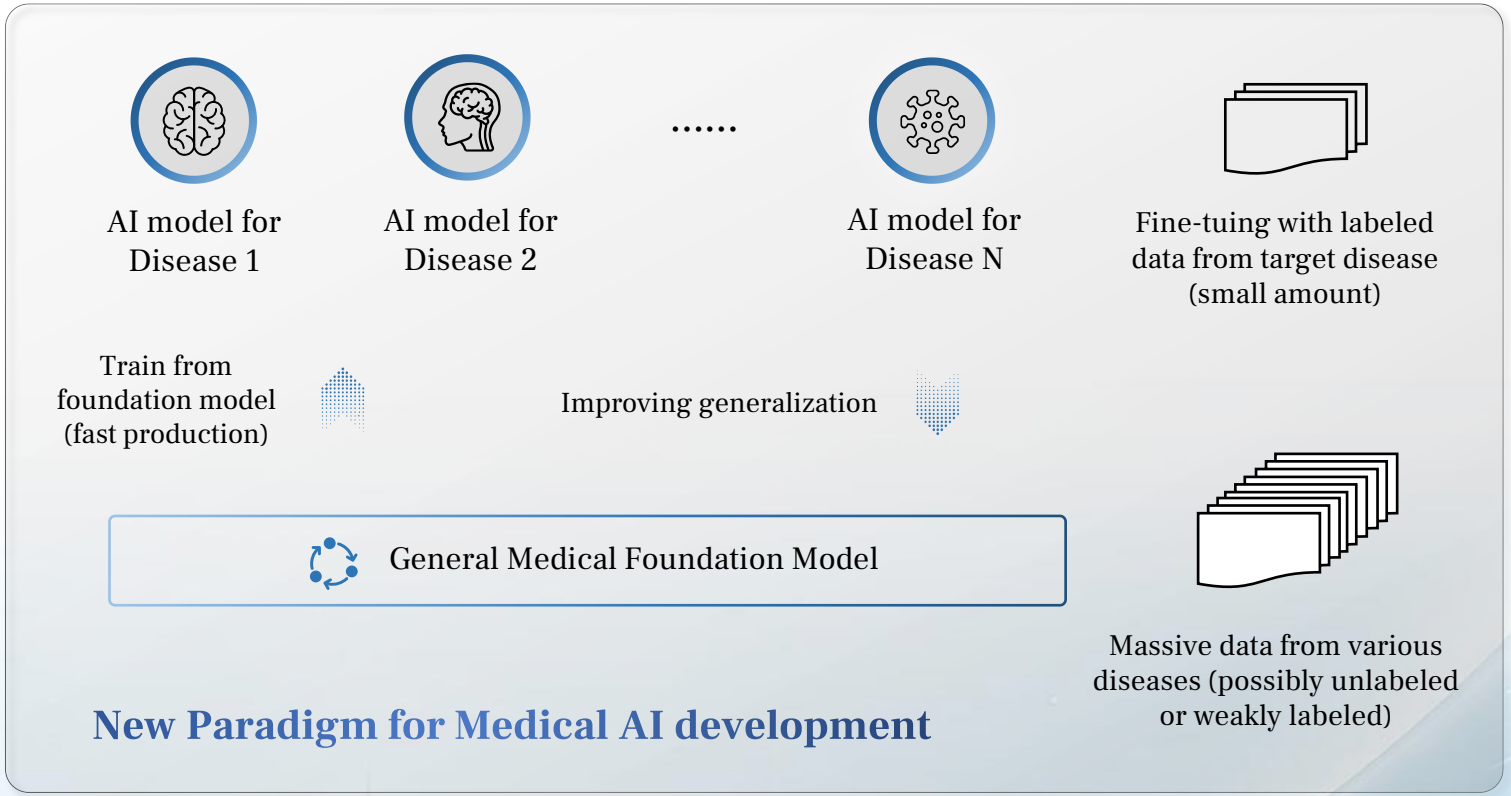
Construct medical language / knowledge foundation models by fine-tuning large language models with medical text data

Medical Mixed Foundation Model

Construct mixed foundation model by fusing multi-modal information (e.g., image, text, video) in medical scenario

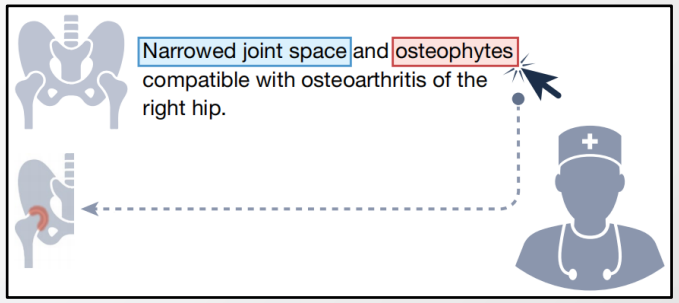
Paradigm Shifts in Medical AI Development





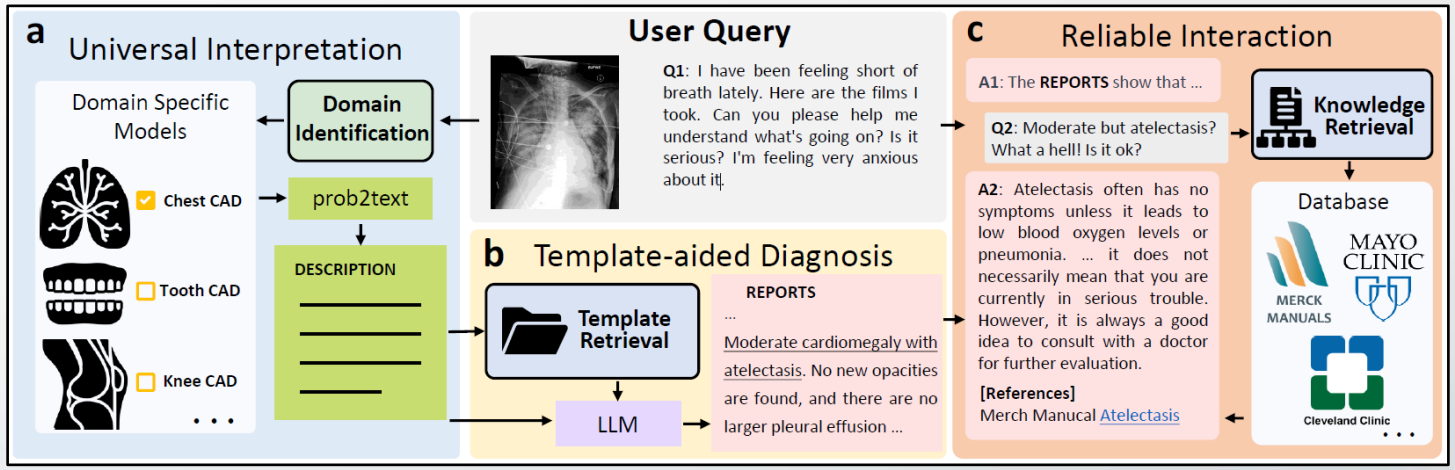
New Scenarios Enabled by Foundation Models

Grounded Radiology Report



- Automatically draft radiology reports that describe both abnormality and relevant normal findings
- Pairing text reports with interactive visualization
- Support chatting and is able to explain the radiology report by visual grounding

Personalized AI Family Doctors for Patients



- Enable accessibile communication on patient's schedule anywhere, not clinicans' schedule on site.
- Build a holistic view of patient's condition using multiple modalities, interact with patient and provide detailed advice and explaination.

Moor, M., Banerjee, O., Abad, Z.S.H. et al. Foundation models for generalist medical artificial intelligence. Nature 616, 259–265 (2023).

Zhao, Z., Wang, S., Gu, J. et al. ChatCAD+: Towards a Universal and Reliable Interactive CAD using LLMs. arXiv preprint arXiv: 2305.15964 (2023).

Thank you

for your attention

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