TACKLING THE CHALLENGES OF NEXT GENERATION HEALTHCARE

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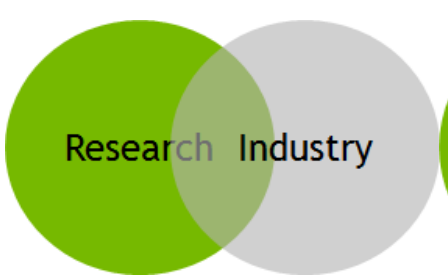
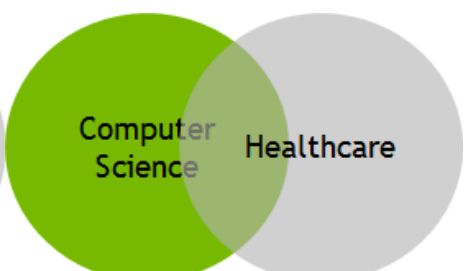
INTRODUCTION

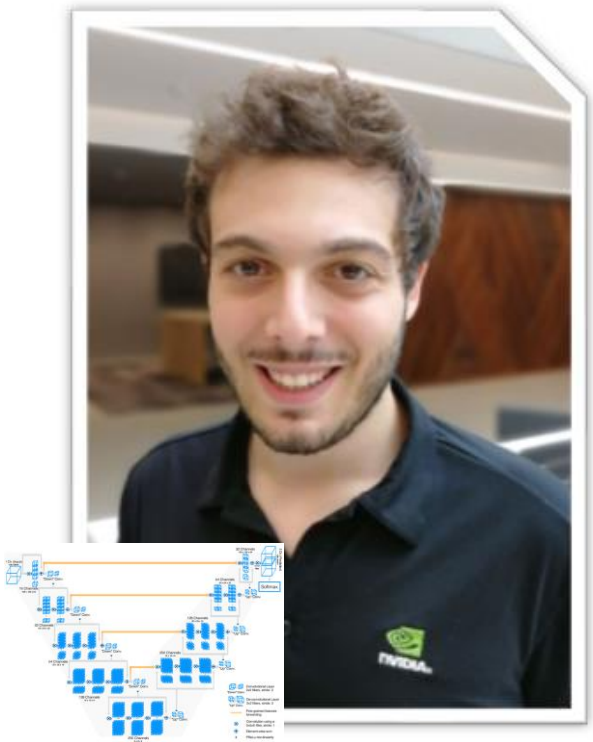
Part of the global NVIDIA Healthcare team

nrieke@nvidia.com

- Senior Solution Architects @ NVIDIA
- Certified Deep Learning Institute Instructors





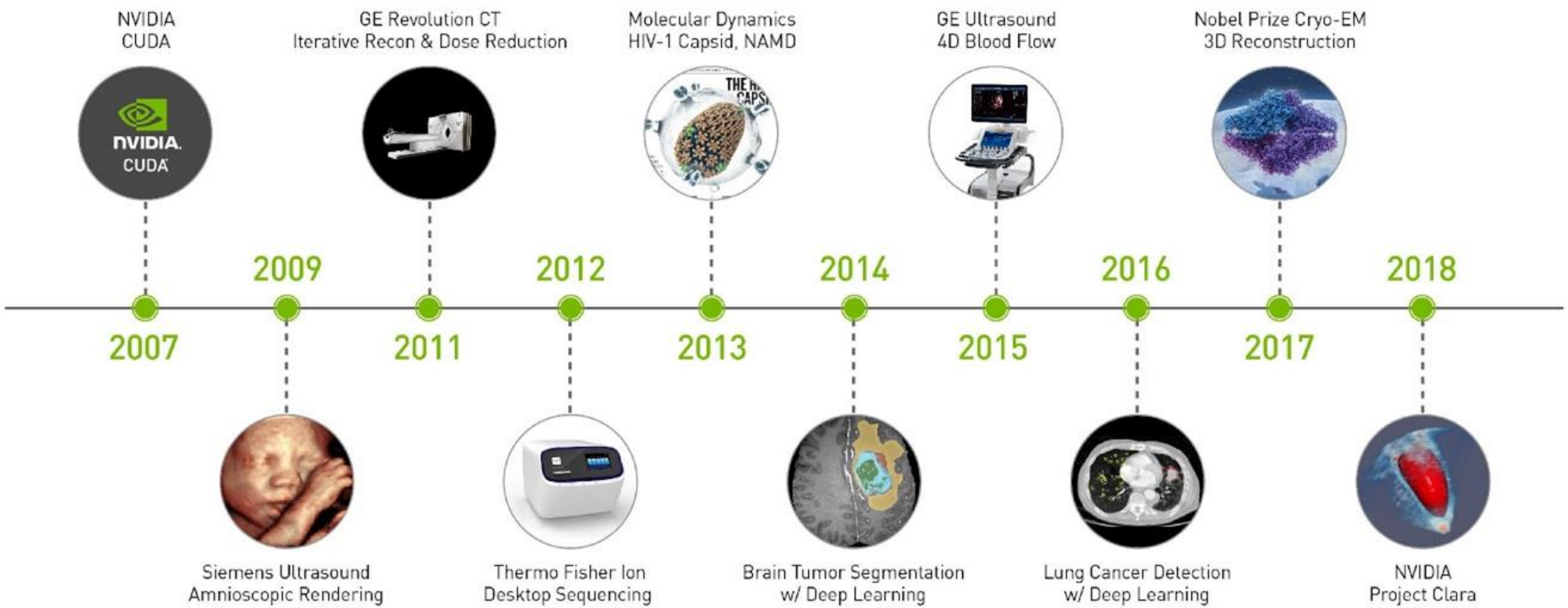


fmilletari@nvidia.com

MEDICAL IMAGING IS A COMPUTATIONAL PROBLEM

Medical imaging is a difficult computational problem, which GPUs have been already solving for the past 10 years. As newer computational platforms become available, novel imaging techniques and improved algorithms can be developed.

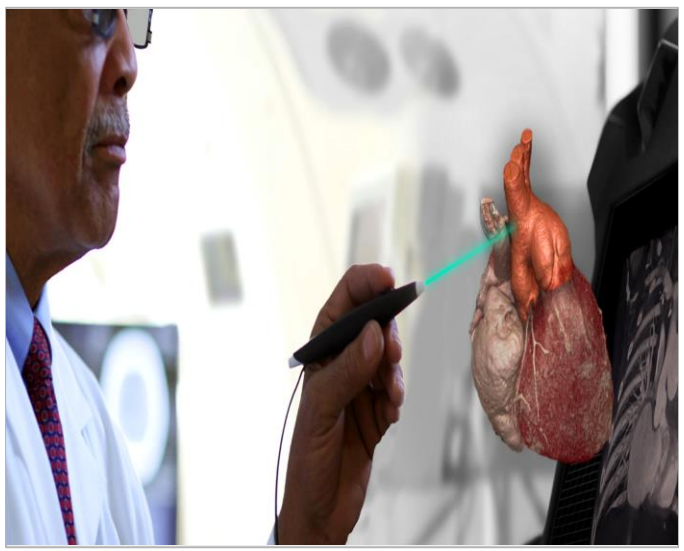
10 YEARS OF INNOVATION IN HEALTHCARE



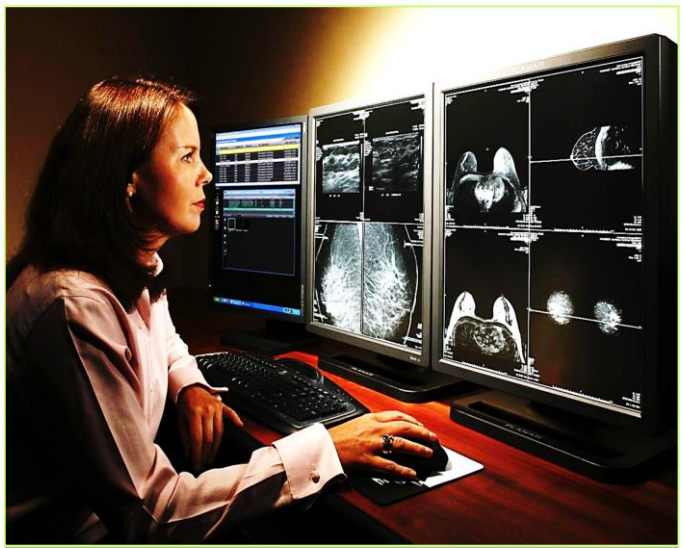
COMPUTATION IN IMAGING

Everywhere!

Reconstruction
Computed Tomography
Magnetic Resonance Imaging
Ultrasound



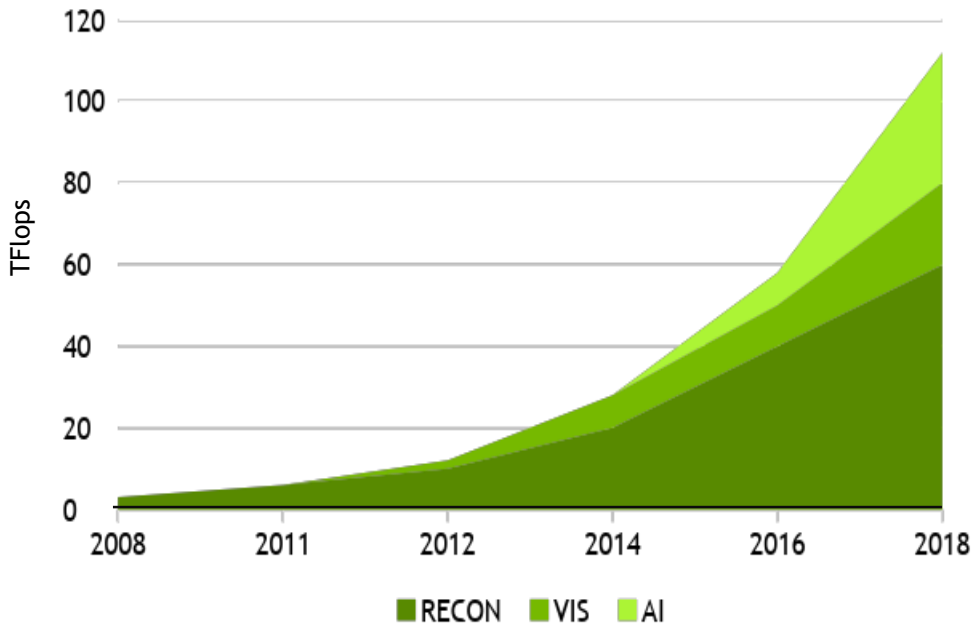
Visualization
2D / 3D Visualization
Medical Simulation
Cinematic Rendering



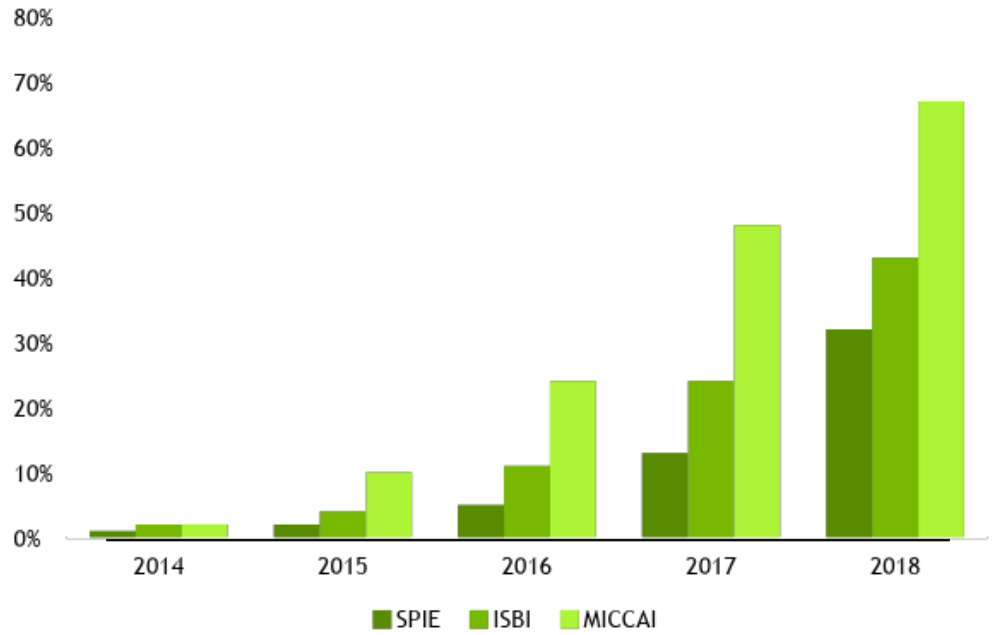
Analysis / Planning
Computer-aided Diagnosis
Radiotherapy Planning
Quantification

MEDICAL IMAGING IS COMPUTATIONAL

10x COMPUTE REQUIRED IN 6 YEARS



70% MEDICAL IMAGING PAPERS USING DEEP LEARNING



“If there is a chance that computer scientists may have the best skill set to fight cancer today, as moral people, aren’t we obligated to try?”

Prof. David Andrew Patterson, New York Times, Dec 2011

Reference: https://www.nytimes.com/2011/12/06/science/david-patterson-enlist-computer-scientists-in-cancer-fight.html

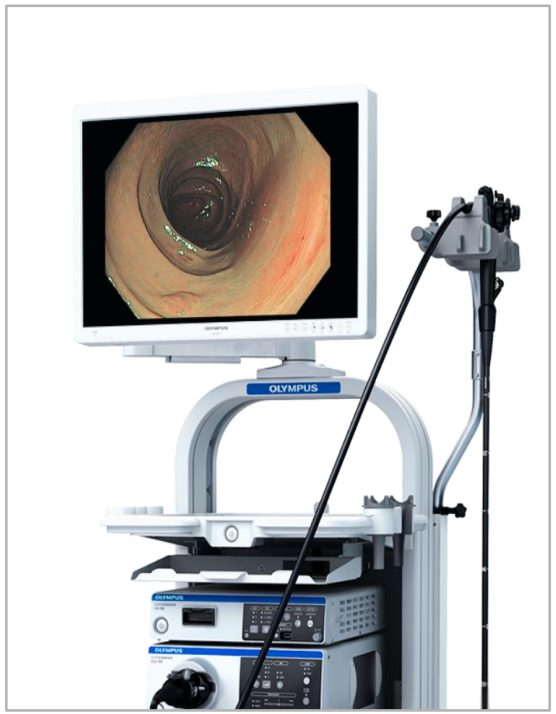
HEALTHCARE IS CHANGING

Developments

Advanced visualisation	More sensors	Big Data
New Modalities	Artificial Intelligence	Precision Medicine
Digitalization	Genomics	AI for Drug Discovery

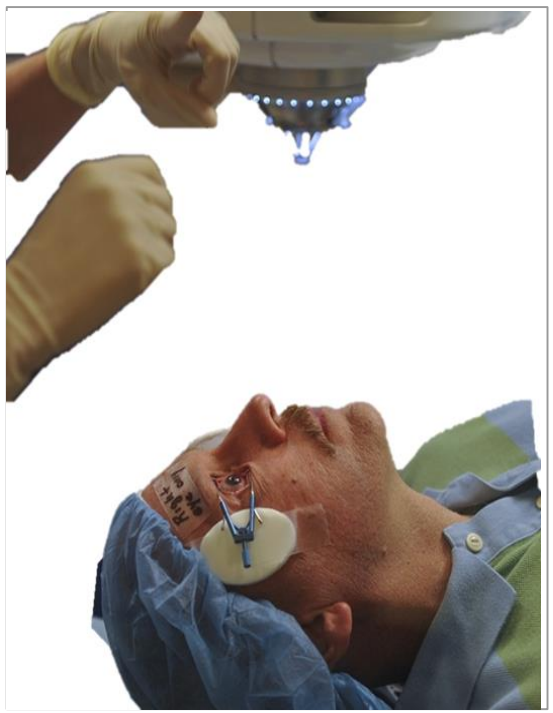
HEALTHCARE IS CHANGING

From Interventions...



ENDOSCOPY

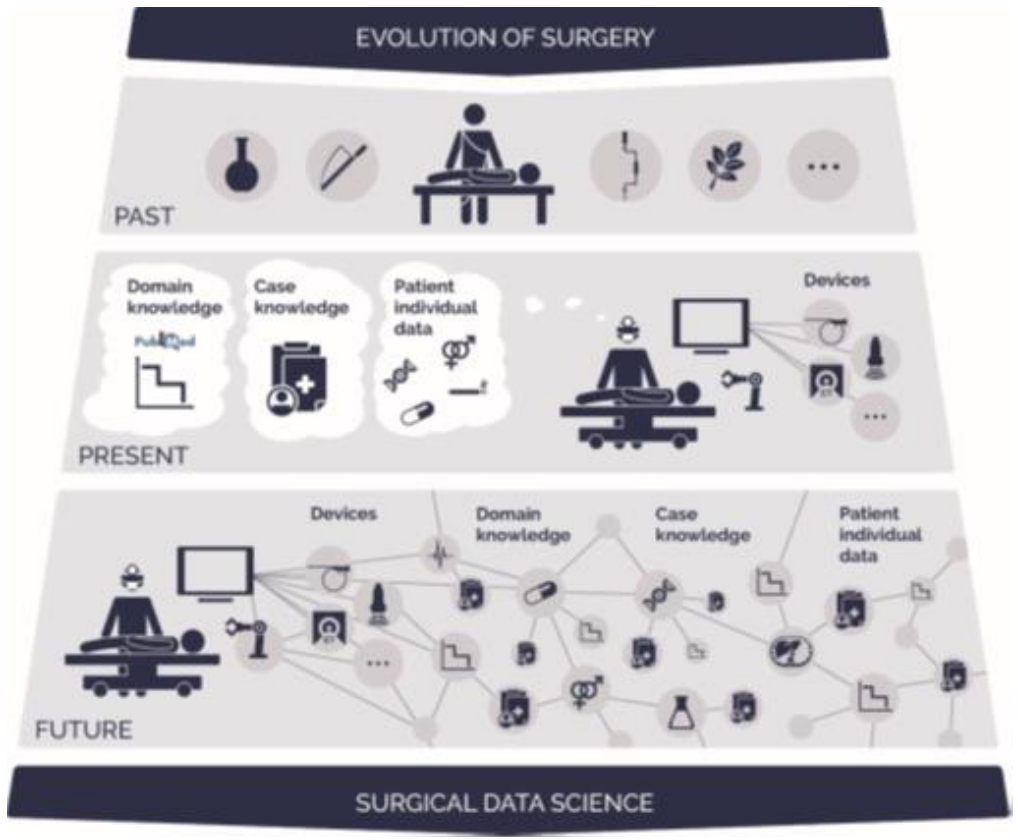
ROBOTIC SURGERY



MICROSURGERY

HEALTHCARE IS CHANGING

… To Next-generation interventions



Maier-Hein, L., Vedula, S. S., Speidel, S., Navab, N., Kikinis, R., Park, A., ... & Hashizume, M. (2017). Surgical data science for next-generation interventions. Nature Biomedical Engineering, 1(9), 691.

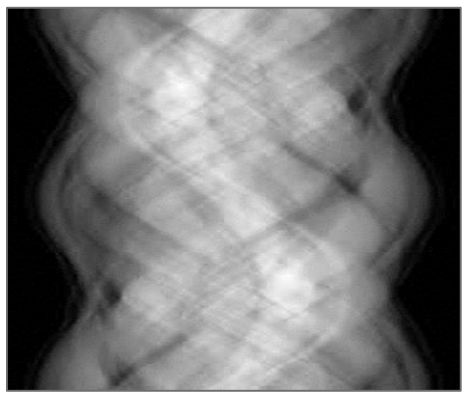
CHALLENGES AND REQUIREMENTS

Medical Imaging is complex

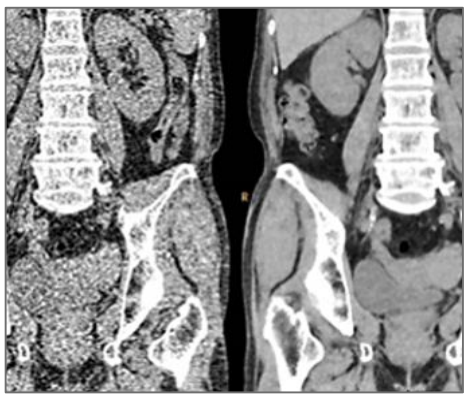
Reliability	Data Size	Compatibility
Safety	Edge Computing / Cloud	Workflow Enhancement
Privacy	Latency	...

CHALLENGE OF MEDICAL IMAGING

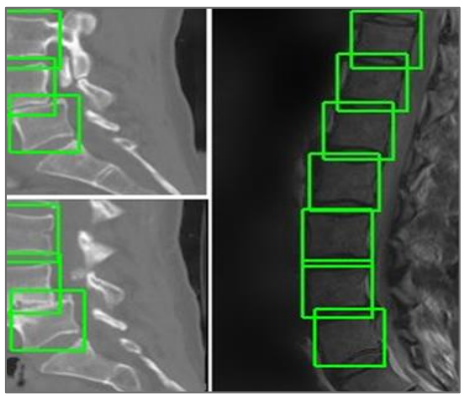
Medical Imaging Instruments and Analysis



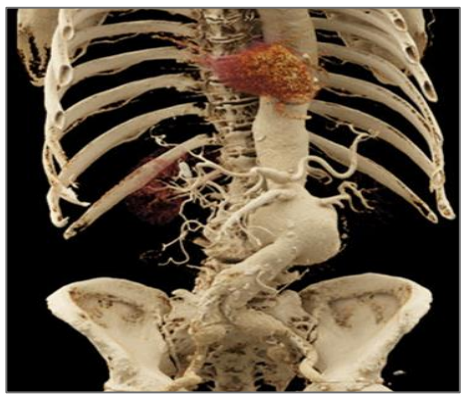
High Speed IO
Sensor Processing



Reconstruction



AI & Image Processing

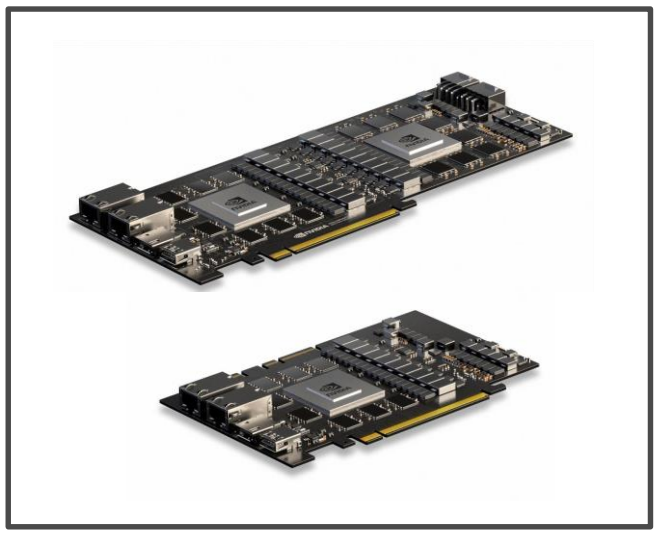


Visualization

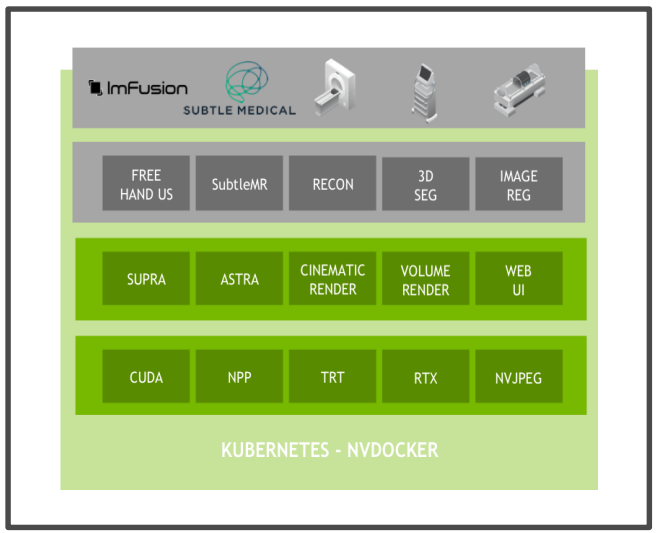
10-1000 GBit/sec

5-50 TFLOPS
1-12 GPUs per instrument
50-1,800W

NVIDIA CLARA PLATFORM



Clara AGX
Next Generation Instruments

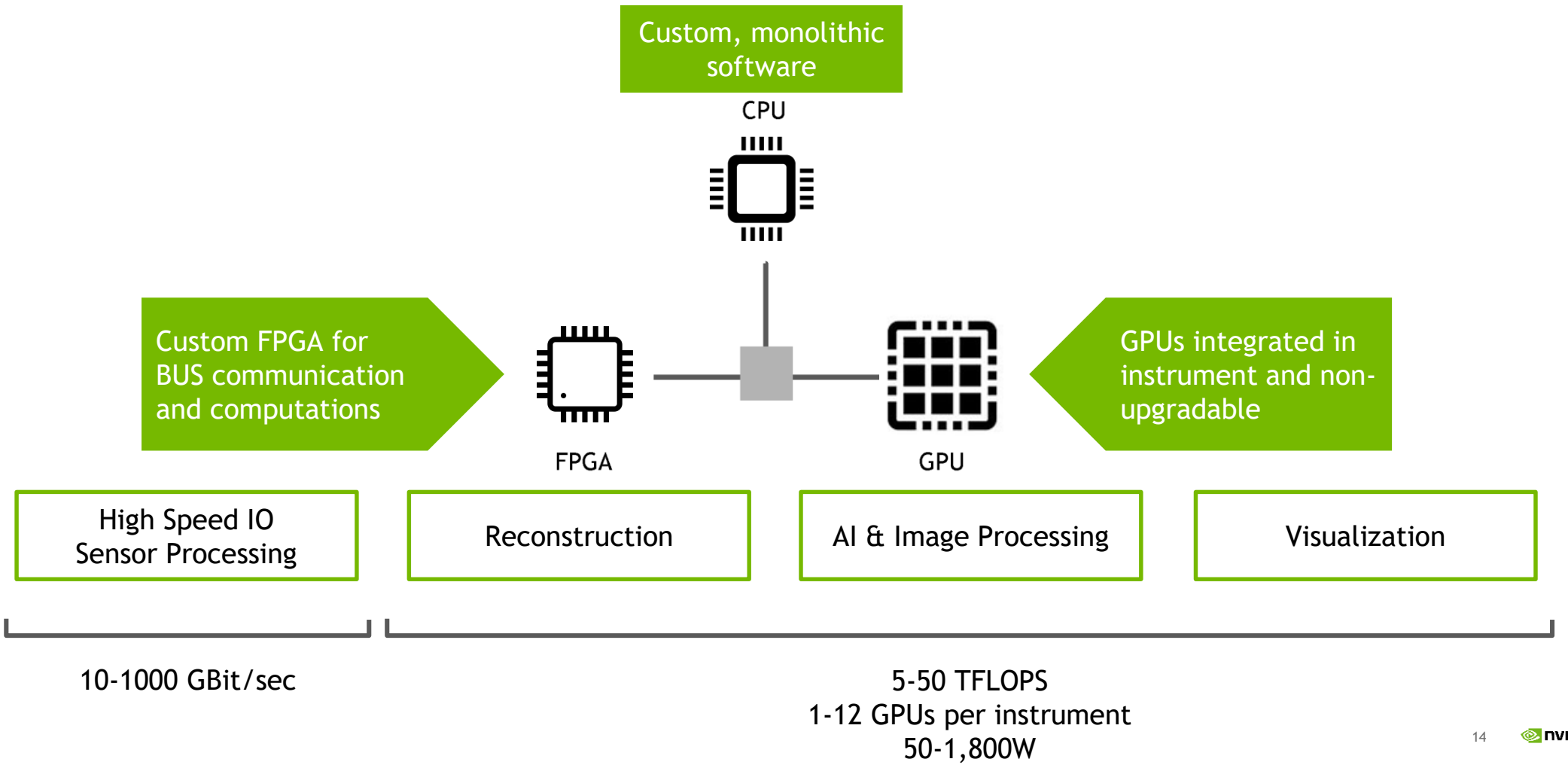


Clara SDK
Upgrade Instrument Install Base

Clara Developers
1000s of Instrument Applications

https://developer.nvidia.com/clara

TRADITIONAL INSTRUMENT ARCHITECTURE



TRADITIONAL INSTRUMENT ARCHITECTURE

High Speed IO
Sensor Processing

Reconstruction

AI & Image Processing

Visualization

10-1000 GBit/sec

5-50 TFLOPS
1-12 GPUs per instrument
50-1,800W

NEXT GENERATION INTELLIGENT INSTRUMENTS

JETSON AGX XAVIER

NVIDIA XAVIER

System on a chip. Volta GPU architecture
16 GB on-board memory
540 CUDA cores with Tensor Cores
30 W power envelope
PCIe interface Gen 4

https://www.nvidia.com/en-us/deep-learning-ai/products/agx-systems

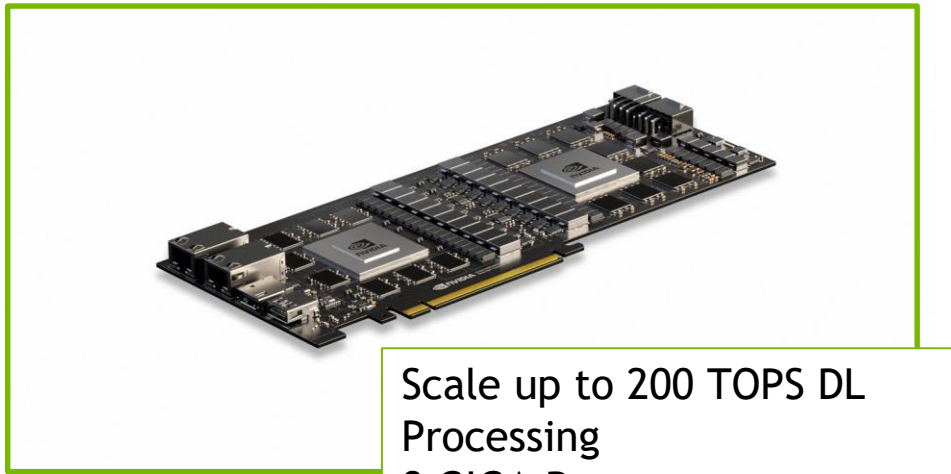
NEXT GENERATION INTELLIGENT INSTRUMENTS

CLARA AGX XAVIER

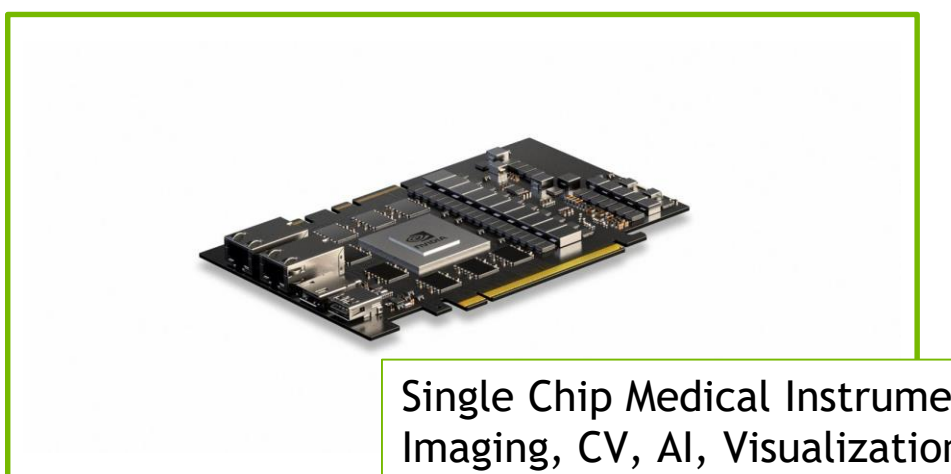
NVIDIA XAVIER + TURING

CUDA, AI, Graphics
Rich High-Speed Sensor IO
Scalable Compute with Turing GPU
Intelligent with Tensor Cores

https://www.nvidia.com/en-us/deep-learning-ai/products/agx-systems



Scale up to 200 TOPS DL Processing
8 GIGA Rays
200W



Single Chip Medical Instrument, Imaging, CV, AI, Visualization on One Chip
30 TOPS DL Processing

NVIDIA PLATFORM

Discrete GPUs
Available via retail in 200+ countries

DGX Family
The HPC appliance for instant productivity

NVIDIA TESLA
Servers in every shape and size

CISCO · CRAY · DELL · hp · IBM · Lenovo · Quanta Computer

CLOUD
Everywhere

Alibaba.com · amazon · Bai百度 · Google · IBM · Microsoft

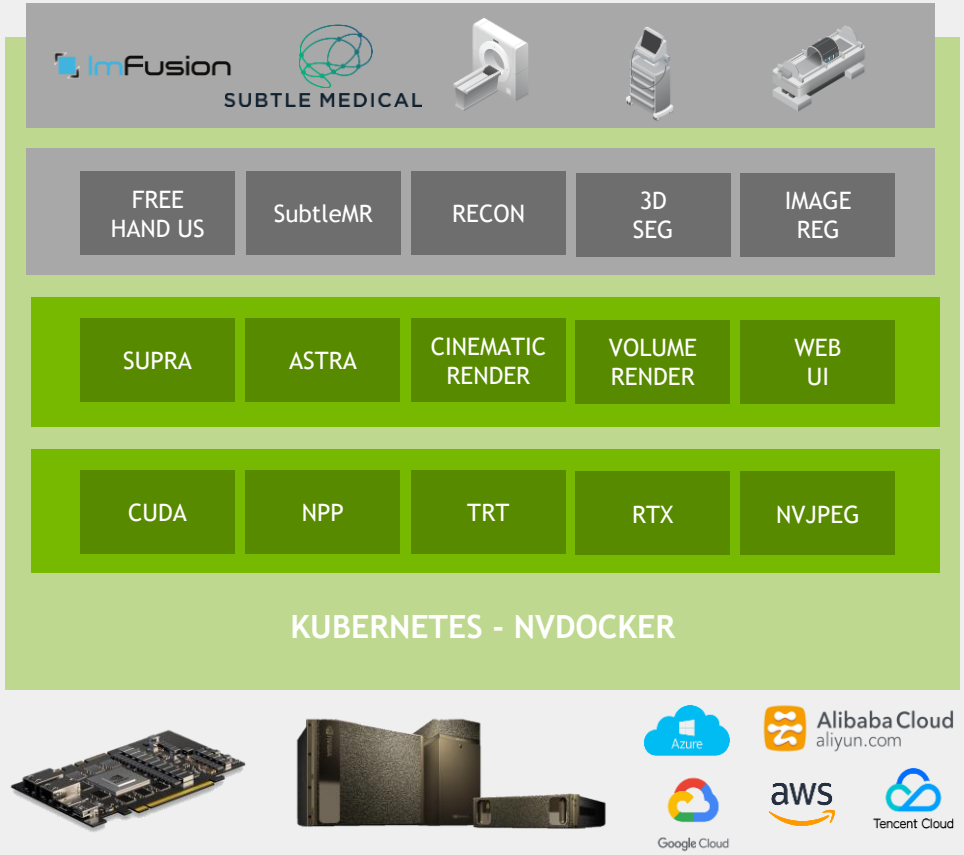
SERVICE ORIENTED ARCHITECTURE FOR HEALTHCARE

NVIDIA CLARA SDK

SDK for Development & Deployment

Compatible with raw and DICOM Data
Supports standalone apps & microservices
Built on NVDocker & Kubernetes for scalability
Accelerated libraries, apps & imaging workflows

https://developer.nvidia.com/clara

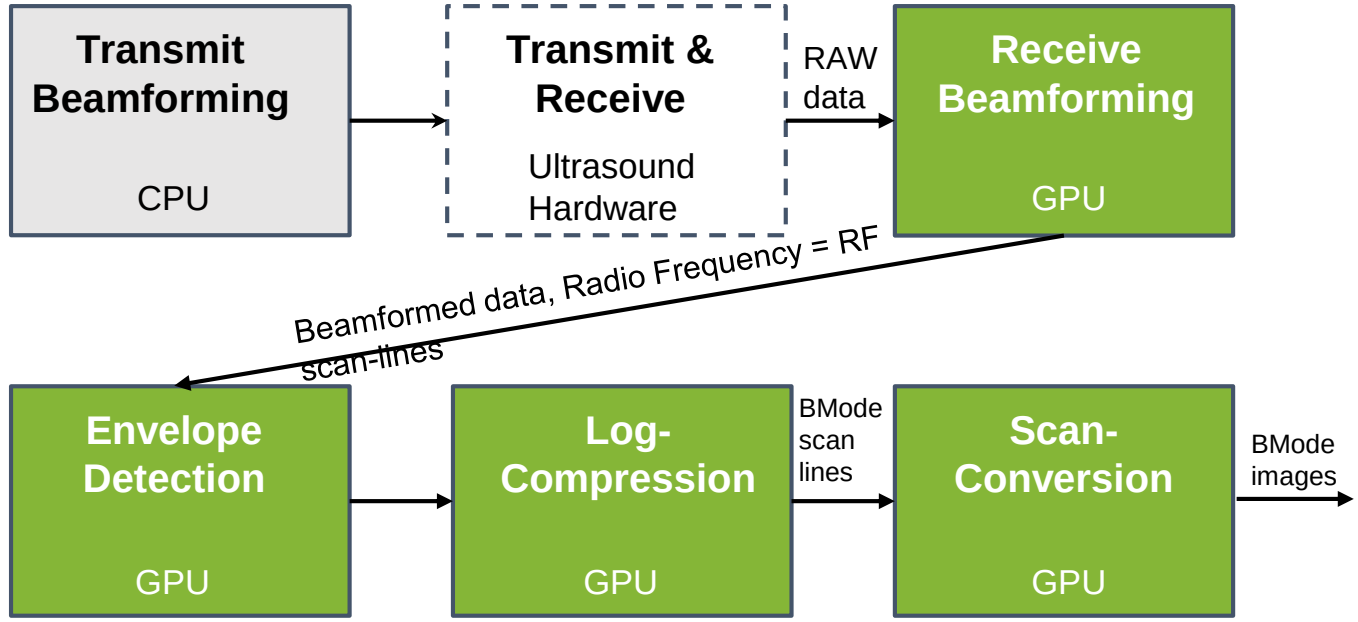


ULTRASOUND IMAGING ON GPU

supra

Adaptive Beamforming is computational

- real-time, end-to-end imaging
- CUDA accelerated
- supports any probe geometry
- hardware agnostic
- advanced processing schemes



CUDA | CuBLAS

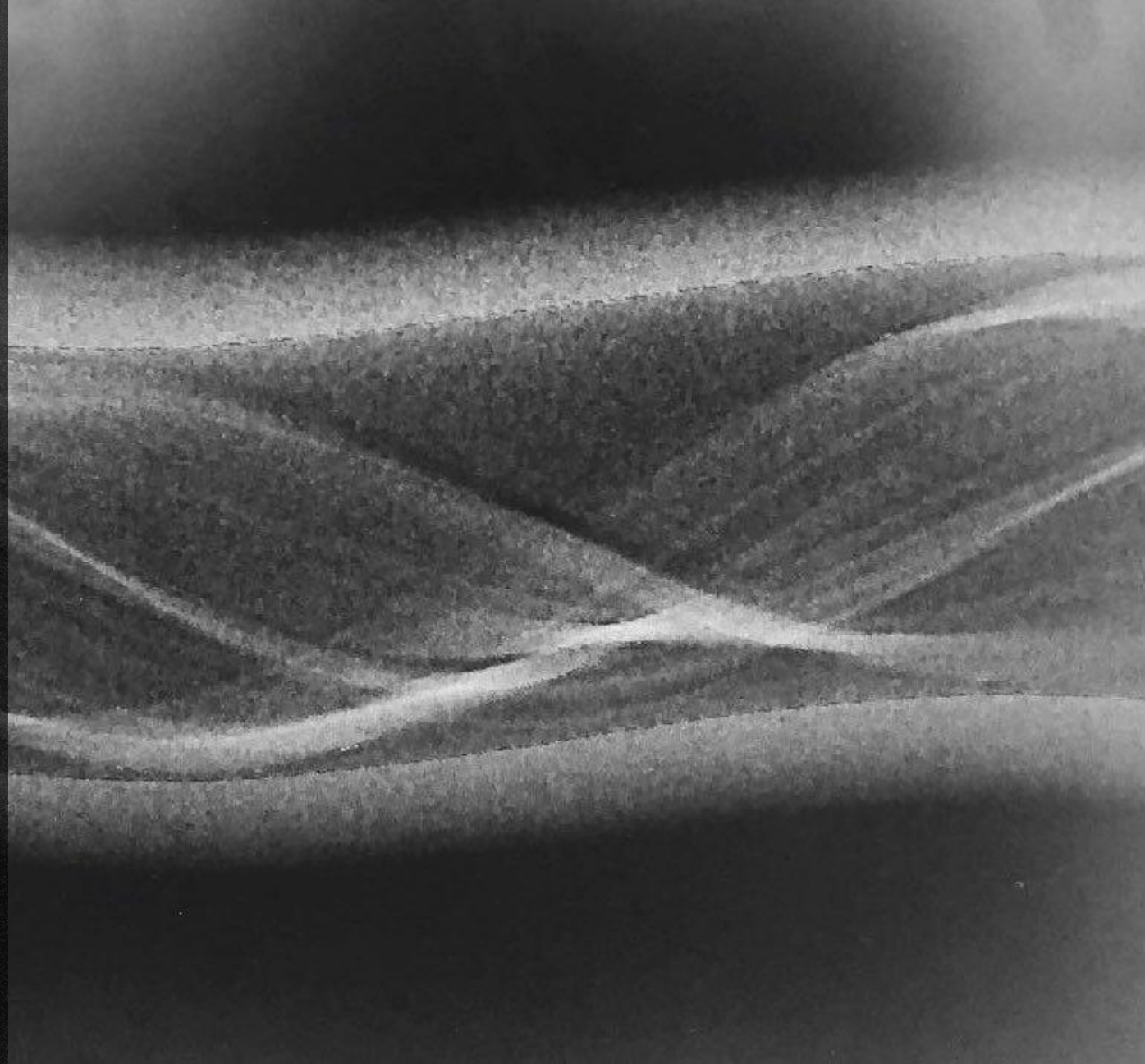
Technische Universität München

BETTER IMAGES AT A LOWER DOSE

ASTRA CT Reconstruction toolbox

- Advanced reconstruction algorithms
- CUDA accelerated
- Supports different scan patterns
- FBP, SIRT, SART, CGSL algorithms

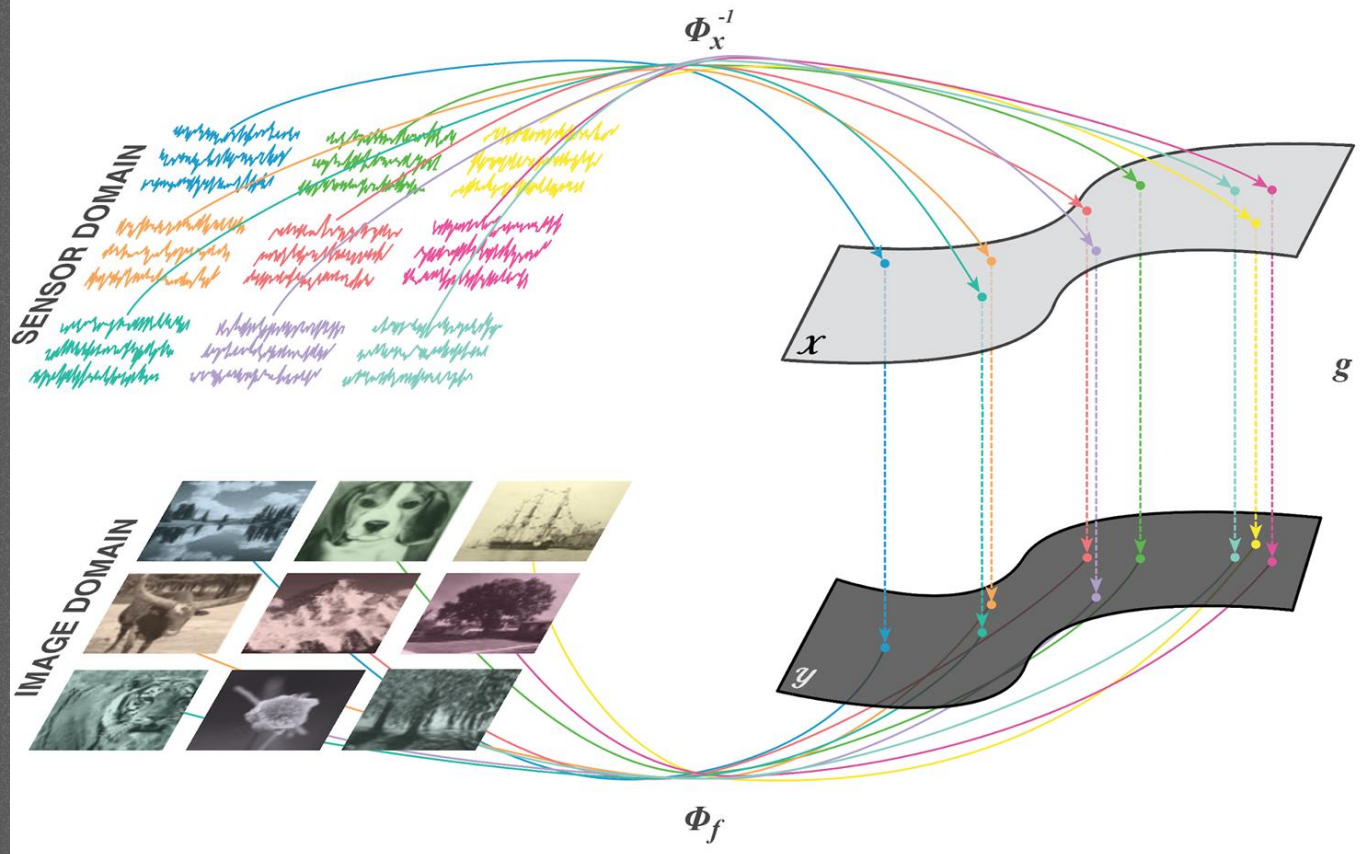
CUDA | CuFFT | CuBLAS



AI IMPROVES IMAGING SPEED AND ACCURACY

MRI reconstruction algorithm with AI

- 100x faster reconstruction
- 5 x higher accuracy
- Works with any acquisition pattern
- Works with heavily downsampled/ aliased signal



TRT | TRT-IS | CUDA | CuDNN

Athinoula A. Martinos Center For Biomedical Imaging

BRAIN TUMOR SEGMENTATION

Encoder - Decoder Architecture with additional VAE branch

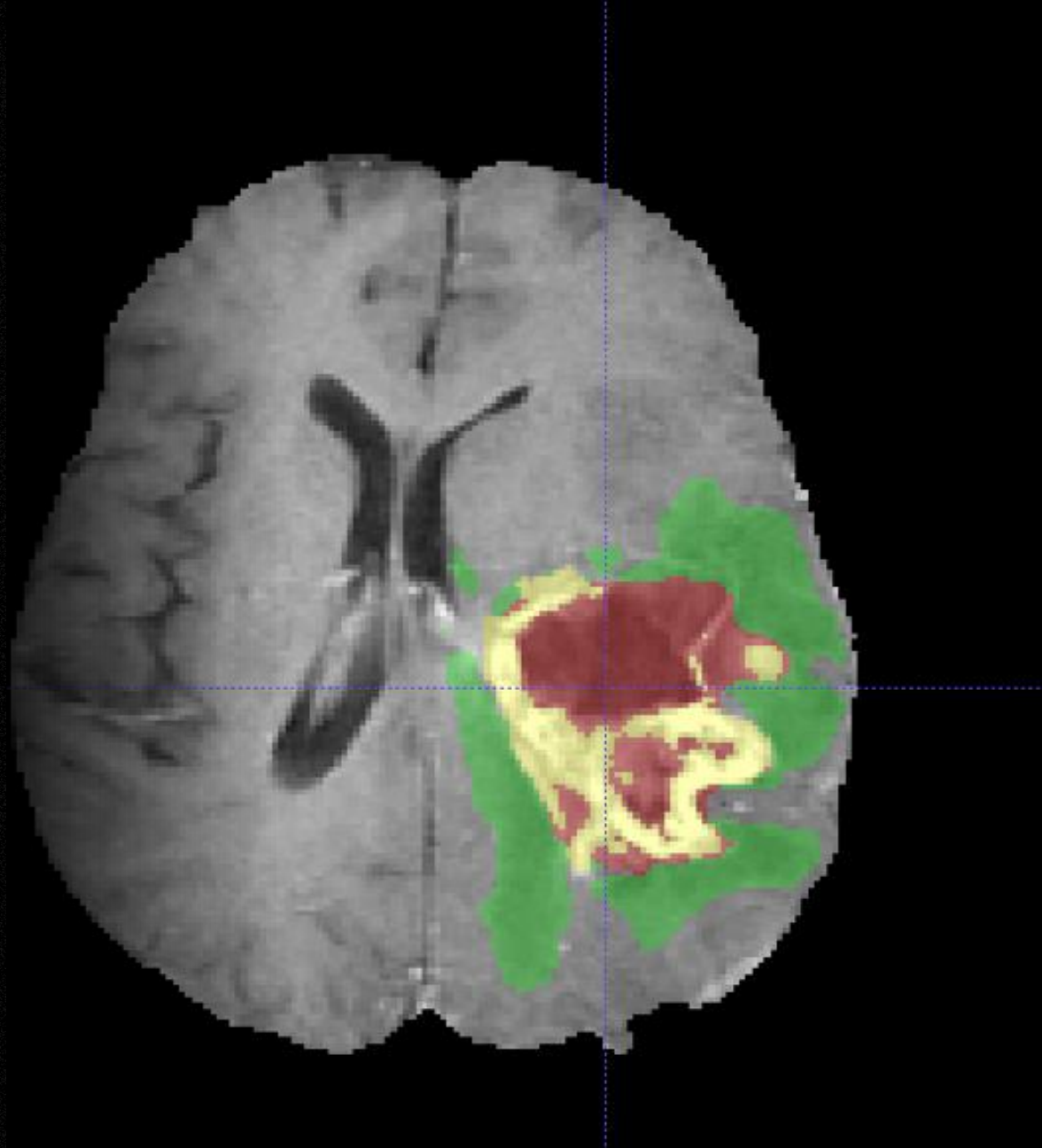
- 1st Place
- Training:
  - 1 GPU, V100-32GB,
    300 epoch training ~ 2days
  - NVIDIA DGX-1 server,
    300 epoch training ~ 6h
- Inference: 0.4 s

NVJPEG | CUDA | TRT | TRT-IS | CuDNN

Multimodal Brain Tumor Segmentation Challenge 2018

BraTS

MICCAI 2018 Granada SPAIN

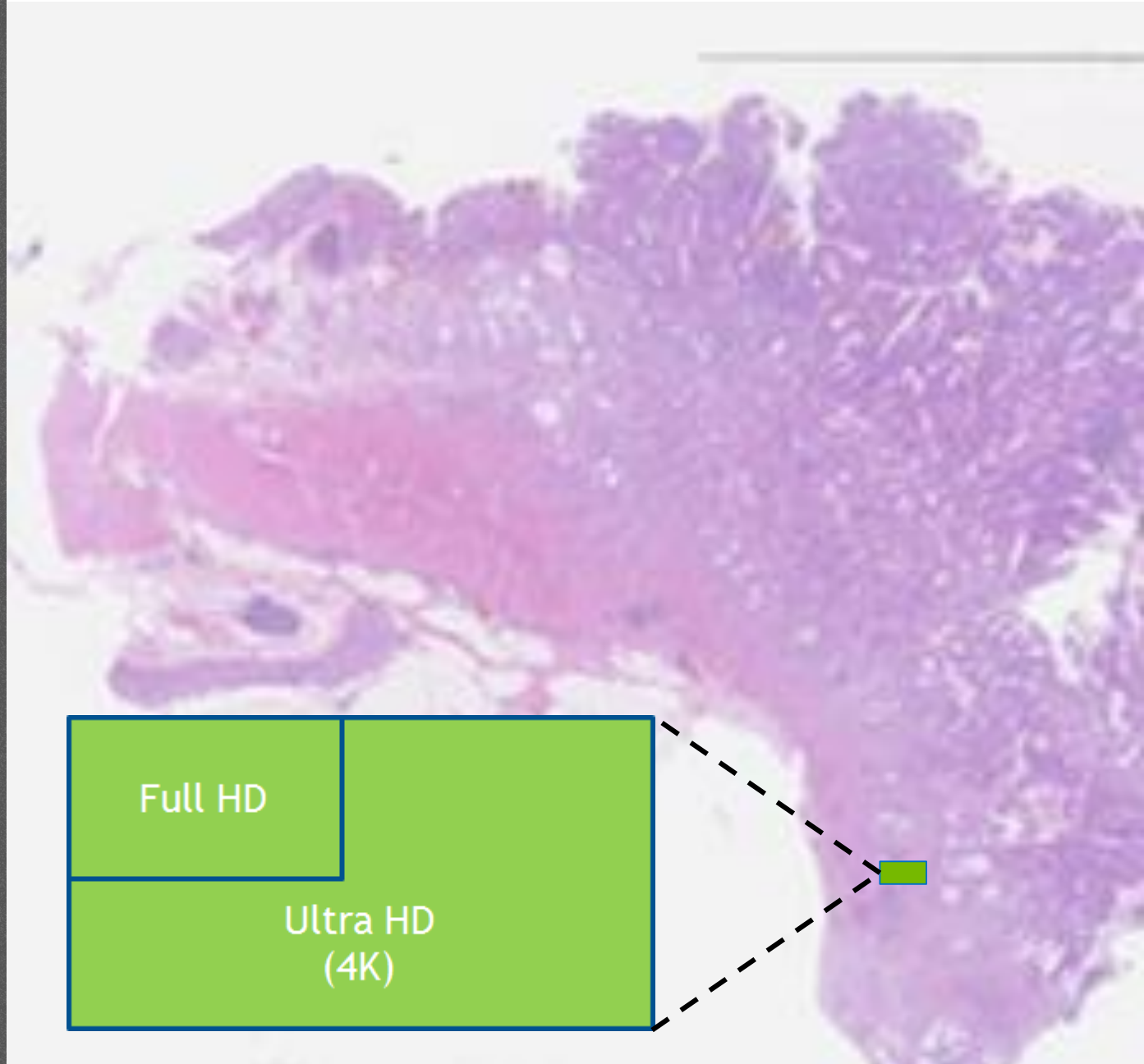


DIGITAL PATHOLOGY

Gland Segmentation

- Very large images:
  180 K x 90 K Image
- Labels often apply to whole image
- high memory requirement!

NVJPEG | TRT | CUDA | TRT-IS | CuDNN



NEXT GENERATION VISUALIZATION

Cinematic rendering

- photorealistic imaging
- offers additional diagnostic insights
- highly computational
- real-time on our platform

RTX | CINEMATIC RENDER | VOLUME RENDER | WebUI

CLARA DEVELOPMENT PARTNERS

GE Healthcare

Cephasonics Ultrasound Solutions

ARTERYS

ImFusion

THE OHIO STATE UNIVERSITY

NUANCE

KHEIRON MEDICAL TECHNOLOGIES

imagia

SUBTLE MEDICAL

inferVISION 推想科技

VISAGE IMAGING®

aidence

zebra MEDICAL VISION

MAYO CLINIC

KING'S College LONDON

NVIDIA

CLARA AGX FOR ULTRASOUND

Platform of choice for next generation products

Cephasonics Announces Next Generation Ultrasound AI to be Powered by the NVIDIA Clara Platform

9/16/2018 **0 Comments**

Santa Clara, CA September 16, 2018 — Cephasonics today announced that it has selected the Nvidia Clara and Xavier framework to power their next generation architecture for Ultrasound AI & deep learning. AI and deep learning will have a dramatic impact not only on the quality of ultrasound imaging, but also on the ability to utilize ultrasound in innovative ways. AI and deep learning will enable ultrasound product developers and researchers to create new high-value imaging applications, where the computer can, not only display an ultrasound image, but also recognize, interpret, measure and act on the image data.

ARCHIVES

July 2018

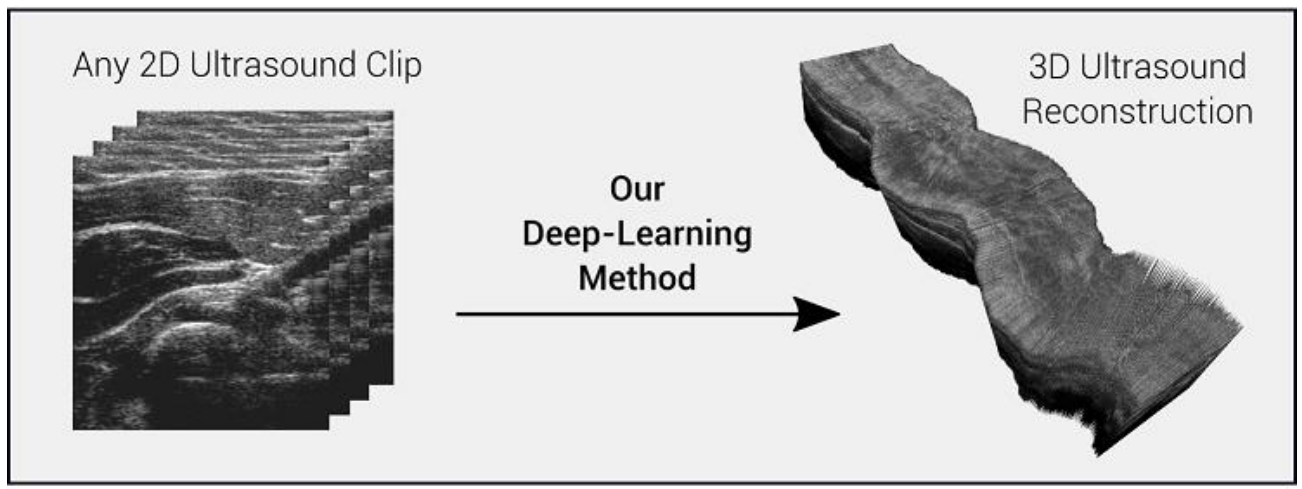
CATEGORIES

All

RSS Feed

NVIDIA CLARA AND IMFUSION

Project Clara for next generation ultrasound

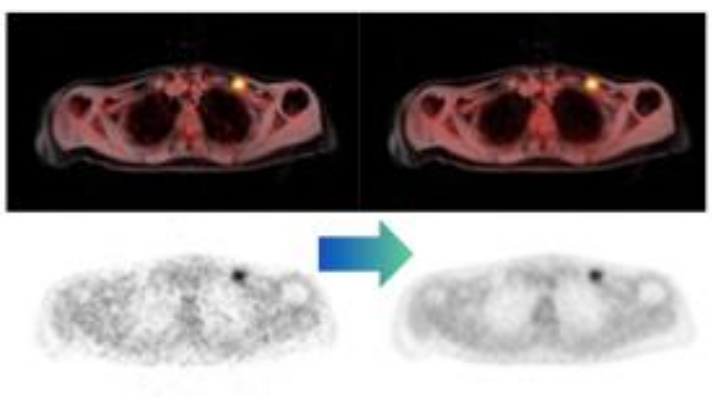


NVIDIA CLARA AND SUBTLE MEDICAL

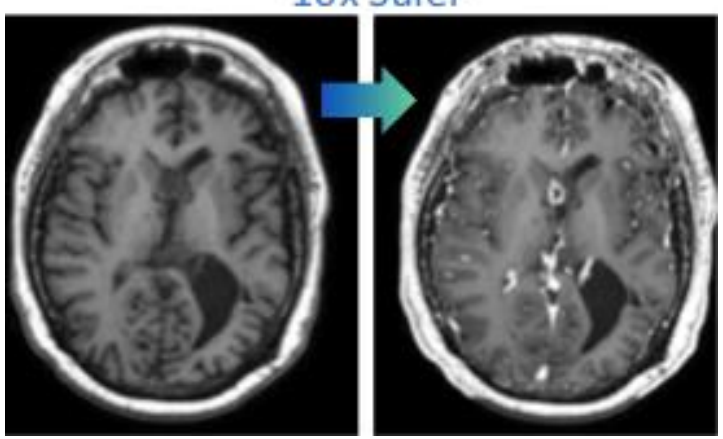
Project Clara to improve PET and MRI imaging

SUBTLE MEDICAL

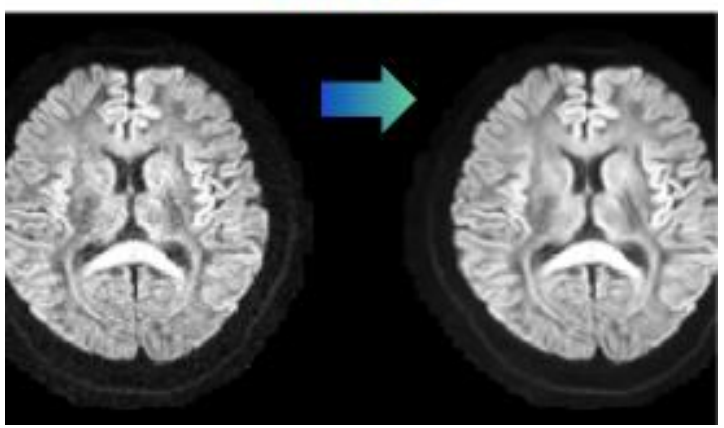
SubtlePET™
4x Faster/Safer



SubtleGAD™
10x Safer

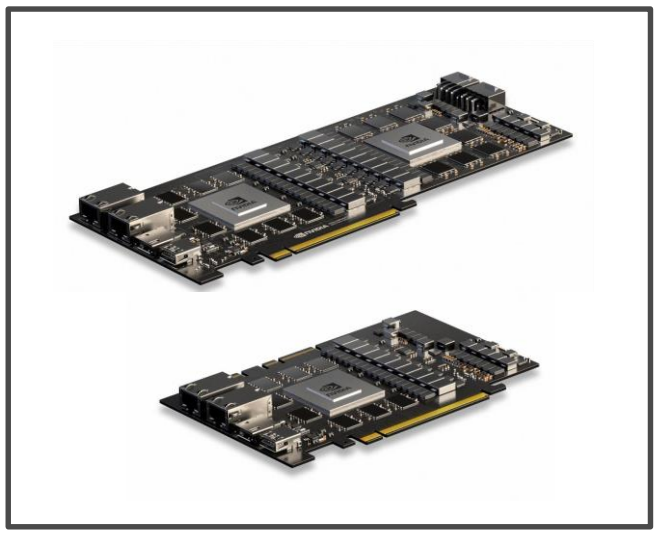


SubtleMRI™
10x Faster

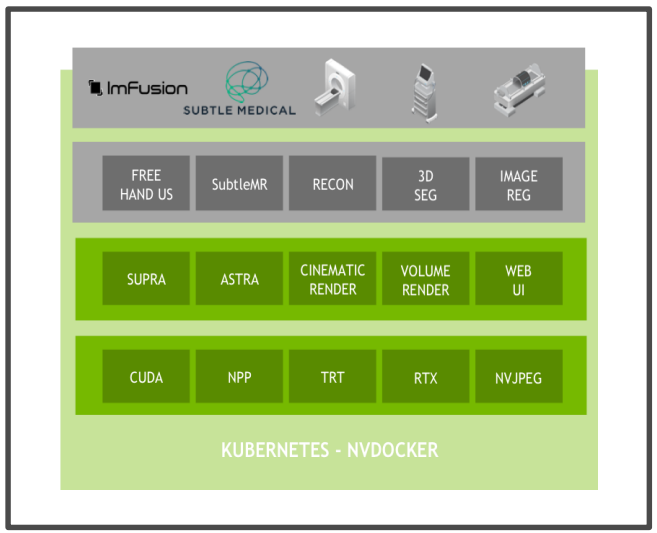


*Disclaimer: SubtlePET is pending FDA clearance. SubtleGAD and SubtleMRI is pre-FDA submission. Not available for commercial sale.

NVIDIA CLARA PLATFORM



Clara AGX
Next Generation Instruments

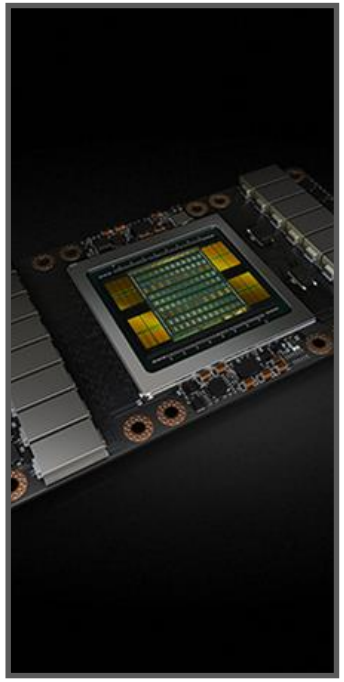


Clara SDK
Upgrade Instrument Install Base

Clara Developers
1000s of Instrument Applications

https://developer.nvidia.com/clara

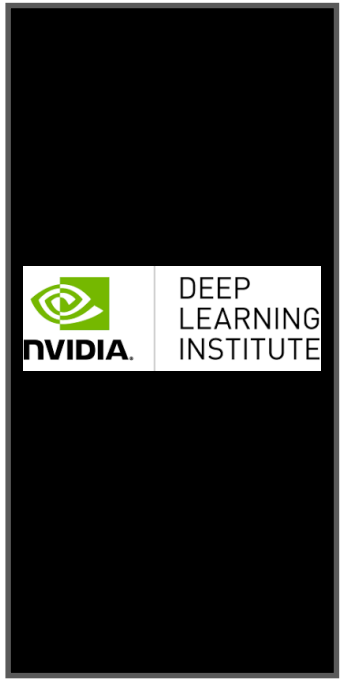
NVIDIA AI PLATFORM - HEALTHCARE



Tesla V100
32GB

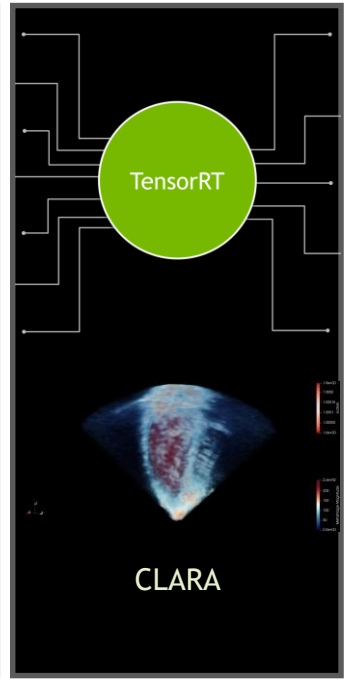
DGX Systems
V100 32GB
DGX-2

NVIDIA GPU Cloud
GPU-Optimized
Containers



NVIDIA DLI
Deep Learning Institute

NVIDIA DIGITS
For fast model
prototyping



NVIDIA AI Inference
PLASTER and Project
CLARA

Thank you!

NVIDIA®