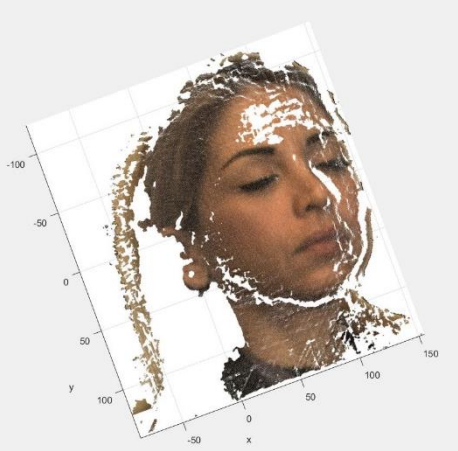
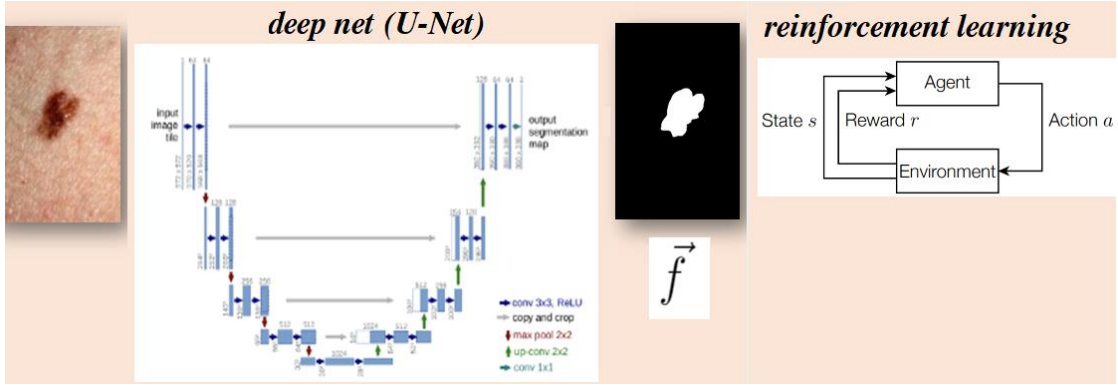




Artificial Intelligence and Augmented Reality in Healthcare

Beril Sirmacek, Dr. –Eng.

AI Expert, Scientist and Entrepreneur

Robotics and Mechatronics
University of Twente

create4D
Creative Intelligence

May 21st , 2019

Key Takeaways

1. Transition from computer science into robotics with augmented reality
2. Cost savings for diagnostics targeting low-cost devices
3. Prototyping to production simplified and enabled by code generation

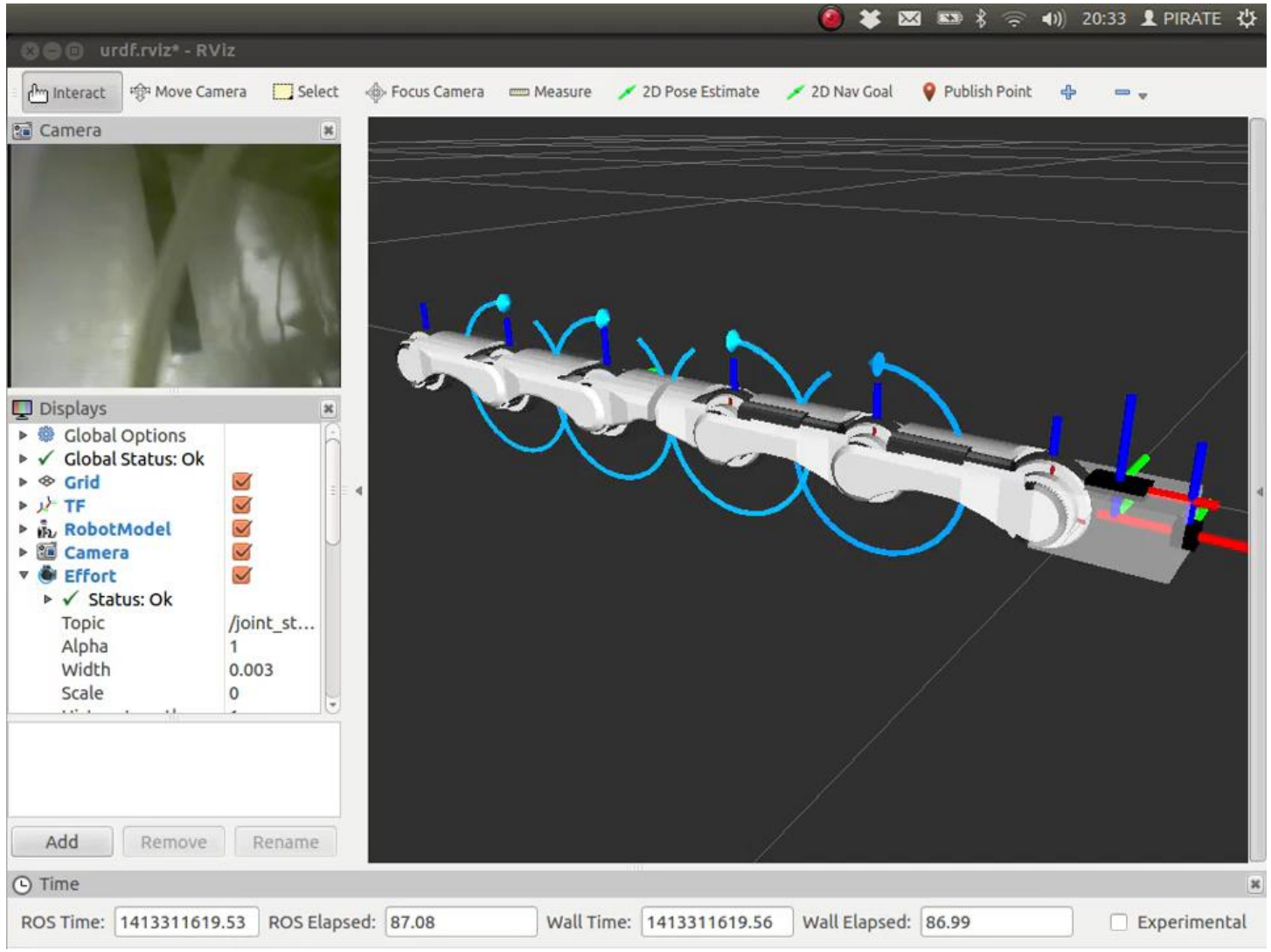
Agenda

- AI and Robotics at University of Twente
- Societal challenges of AI in healthcare
- The big picture of healthcare technology
- Main usage areas of AI in healthcare
- Concluding remarks

Who we are?

RAM ROBOTICS AND MECHATRONICS

Robotic and Mechatronics (RAM), University of Twente

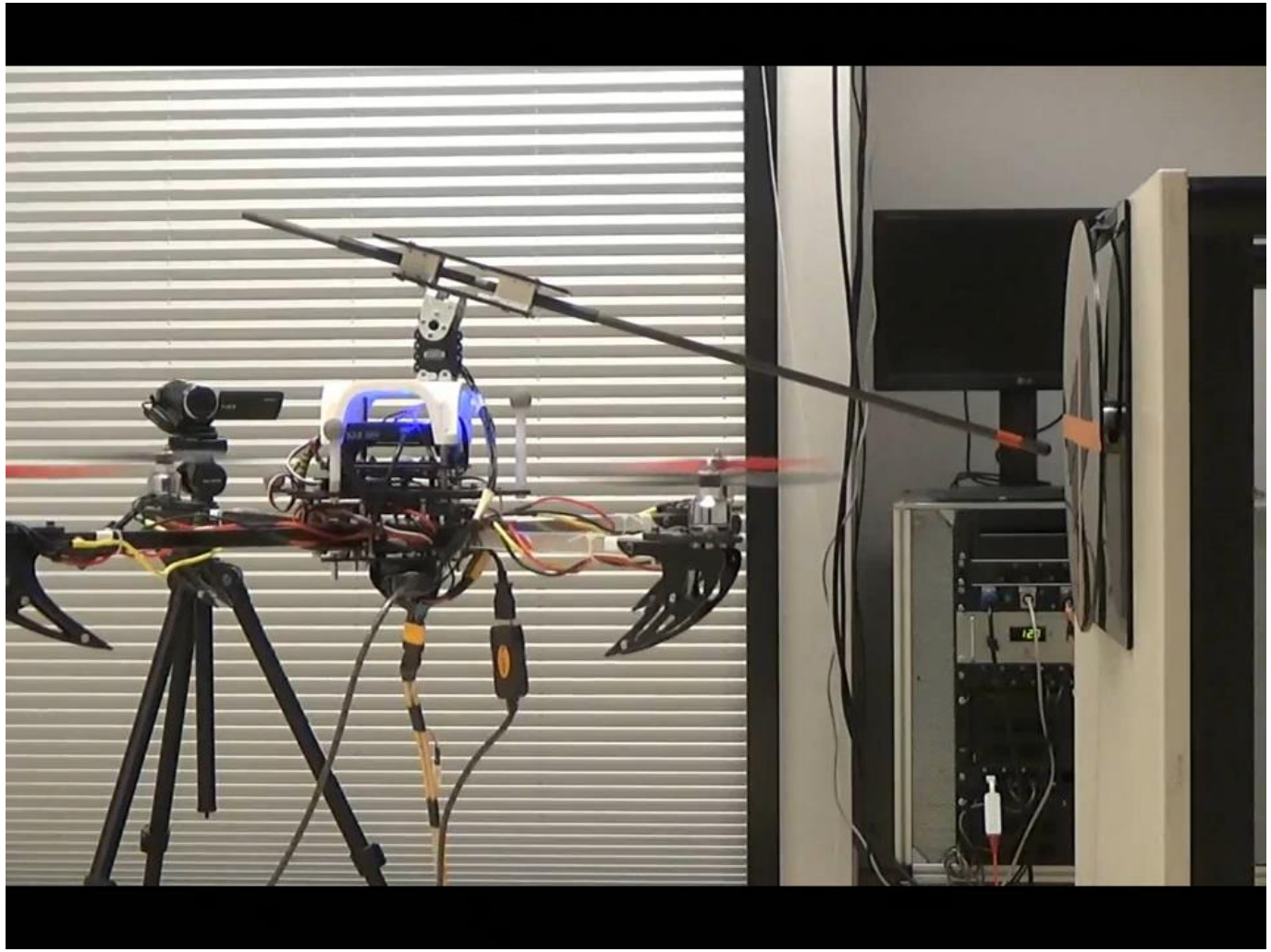


[PIRATE Pipe inspection]

Robotic and Mechatronics (RAM), University of Twente

Robird Project

Robotic and Mechatronics (RAM), University of Twente



Aerial Manipulation: Apply Large Force with UAVs or drones

Societal Challenges of AI in Healthcare

Trustworthy AI must comply 3 components:

- **Lawful**: producing data/experiments/solutions acceptable by laws (FDA)
- **Ethical**: ensuring that the privacy issue of the patients is taken care of and the application + data fits into ethical rules
- **Robust**: Technically and socially

The Big Picture of Healthcare Technology

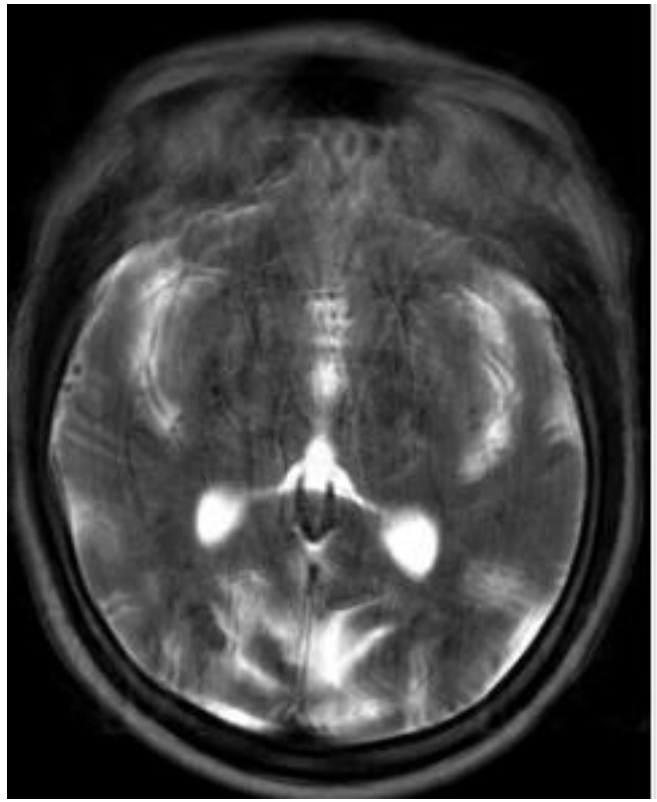
- **Modeling and Simulation:** necessary to minimize too many iterations with patients and clients to converge to a ready-for-production prototype
- **Robotics:** increasing use in surgical procedures and orthopedics
- **IoT , Data Analytics and AI:** Telemedicine and Teleoperation of medical devices on the rise

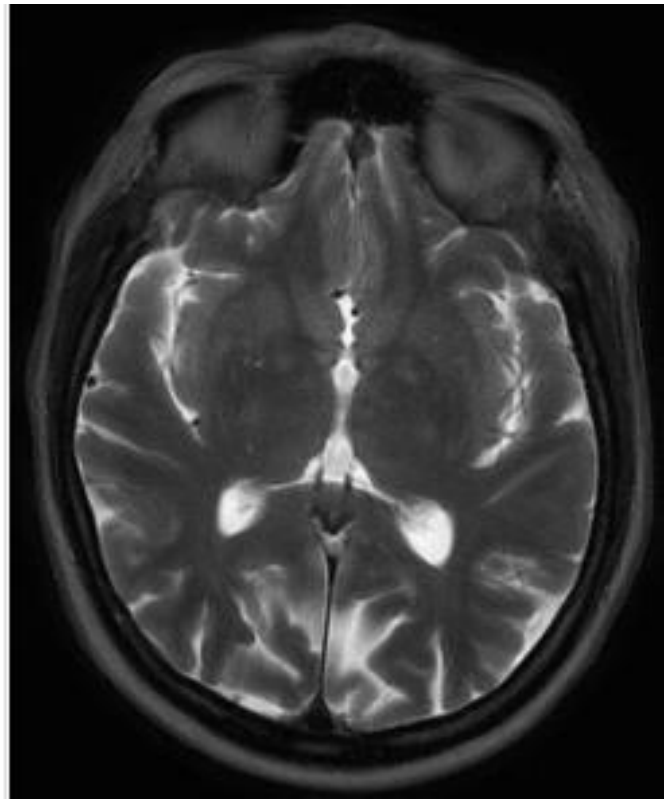
Main usage areas of AI in Healthcare at University of Twente

- Visualization
- Robotics
- Diagnosis
- Decision support

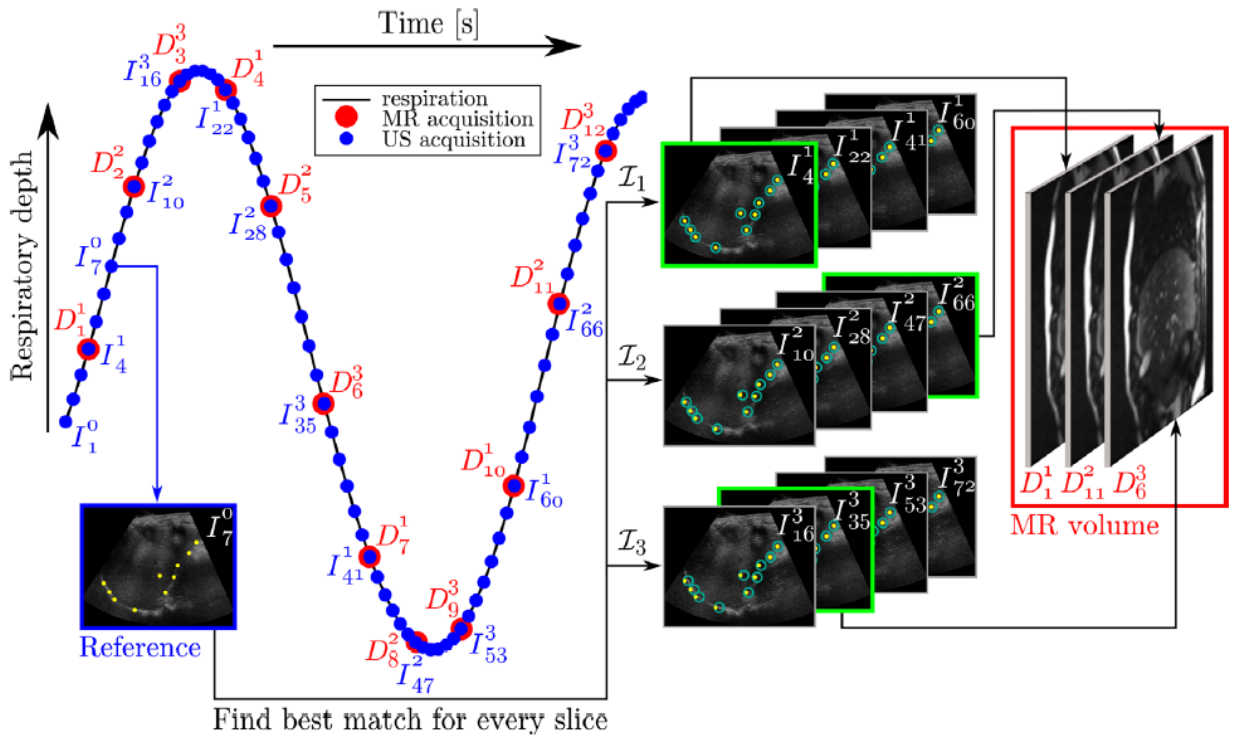
Visualization

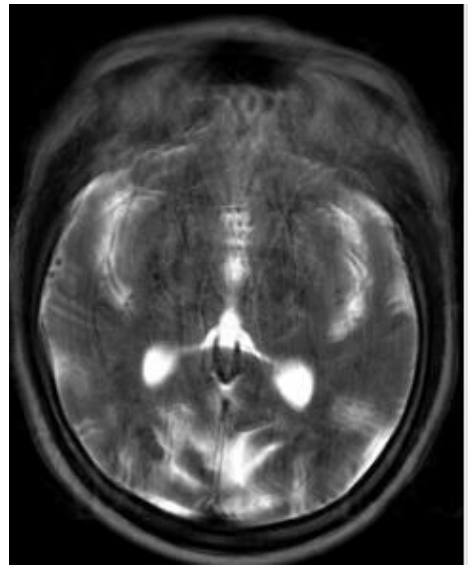
- AI for enhancing data
- 3D rendering
- AR
- Displaying the progress

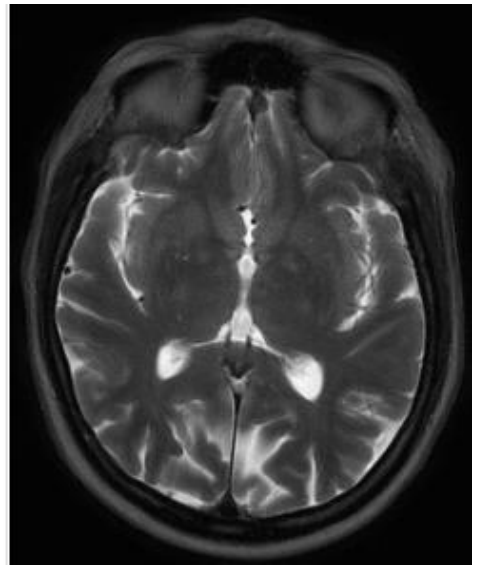




Visualization





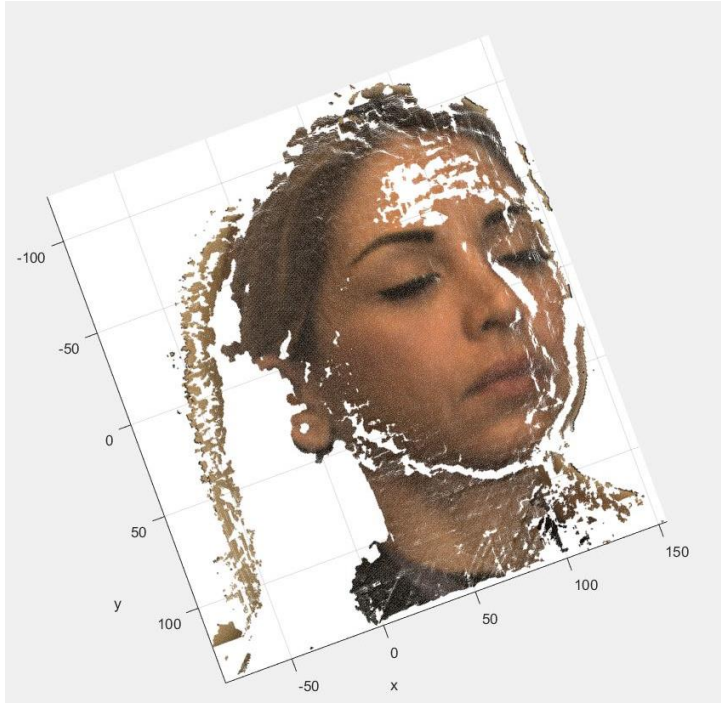


Biggest Advantage of using MATLAB

A single platform for all aspects of the project, including image processing and computer vision, SLAM, and deep learning

Handheld Device

3D reconstruction

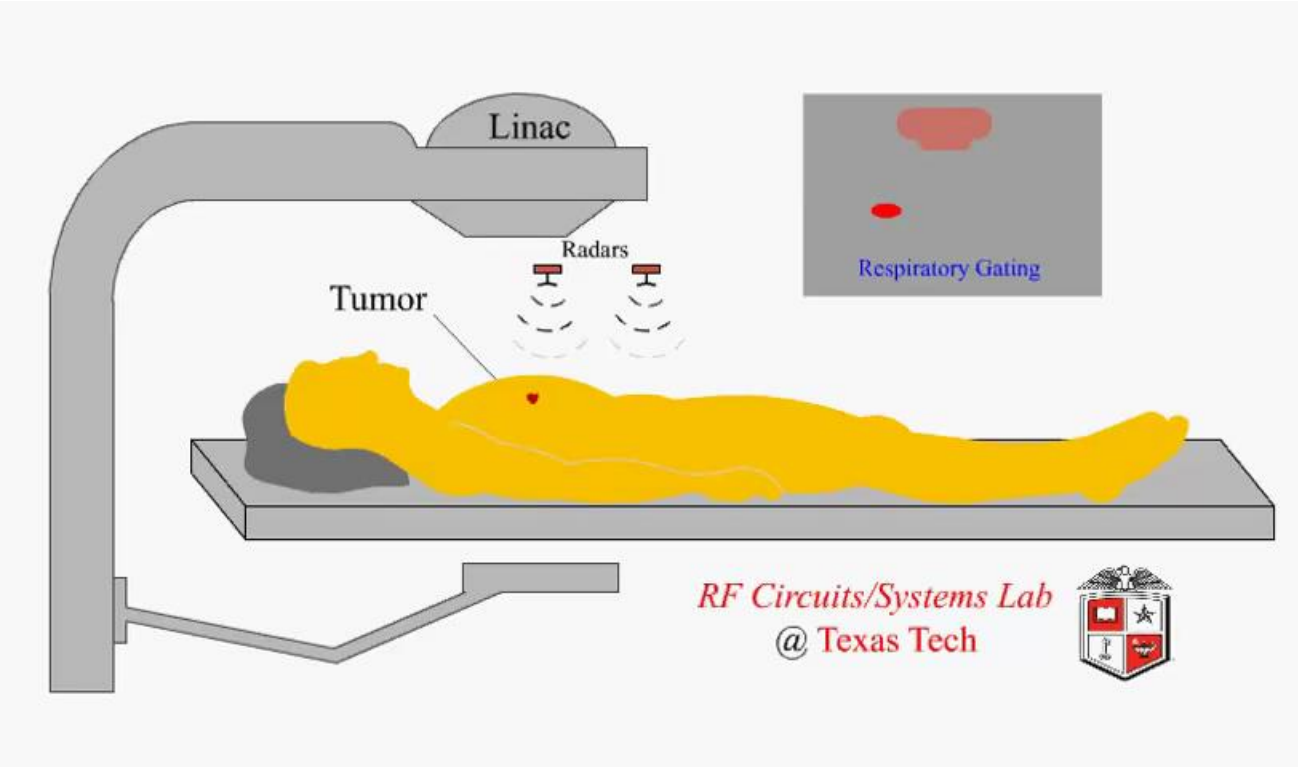


Augmented Reality

https://nl.mathworks.com/company/newsletters/articles/visualizing-and-diagnosing-reduced-blood-circulation-with-augmented-reality-and-deep-learning.html

Robotics

AI for Respiratory motion estimation



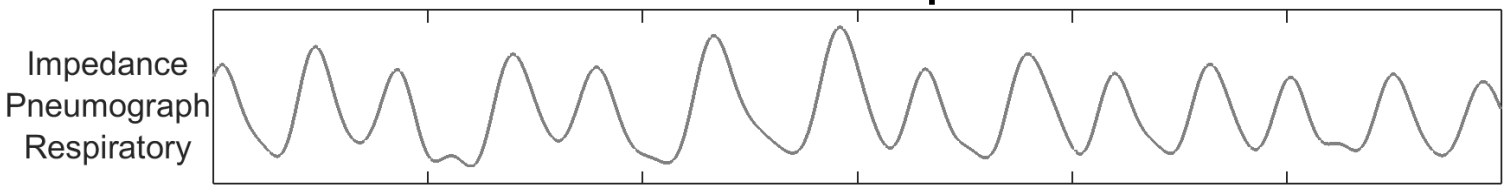
Literature gap:

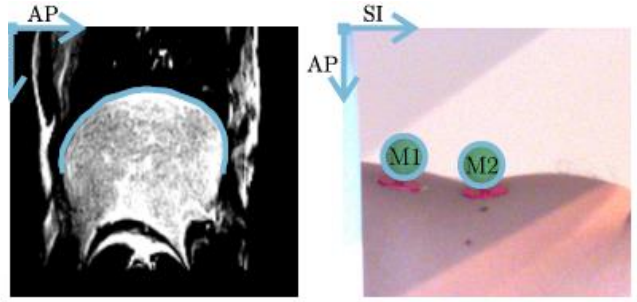
- Breathing mode (deep or shallow)
- Inter- or intra-cycle variations
- Tumor size or mass
- Location of the tumor
- Properties of the tissues

Robotics

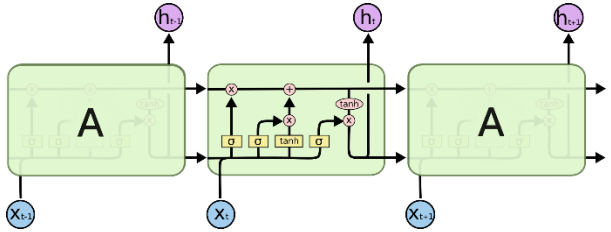
AI for Respiratory motion estimation

Critical care patients

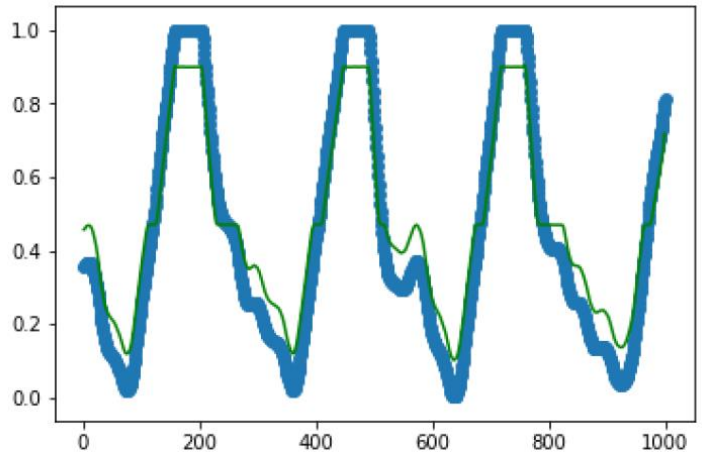


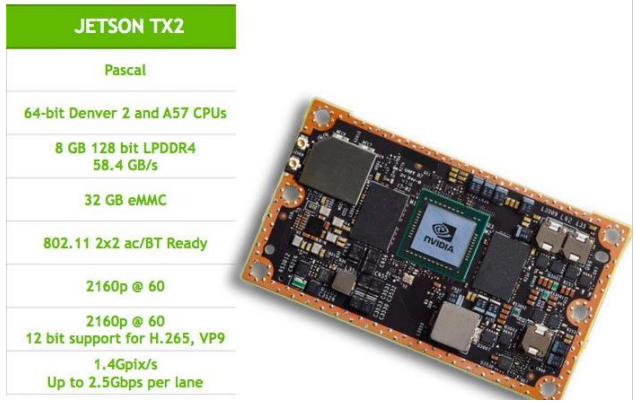


LSTM structure



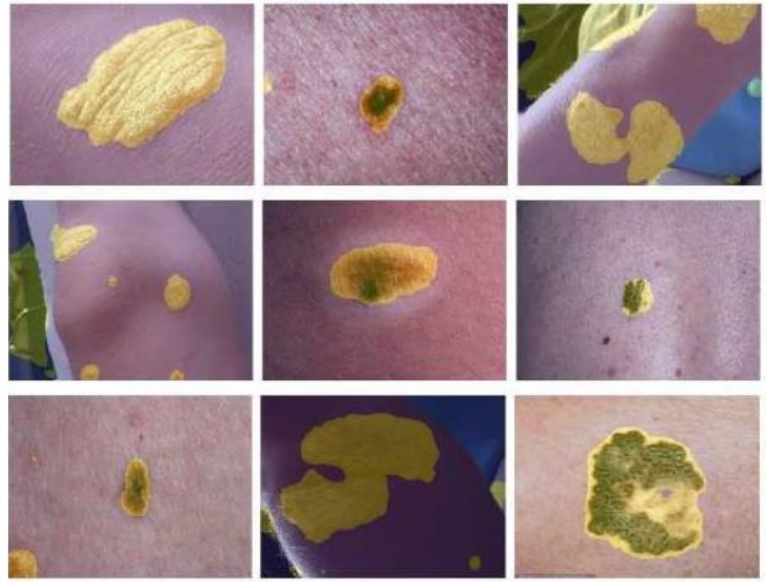
Our overall test data sets gives 0.09 as the RSME on the estimated value and real value comparisons.





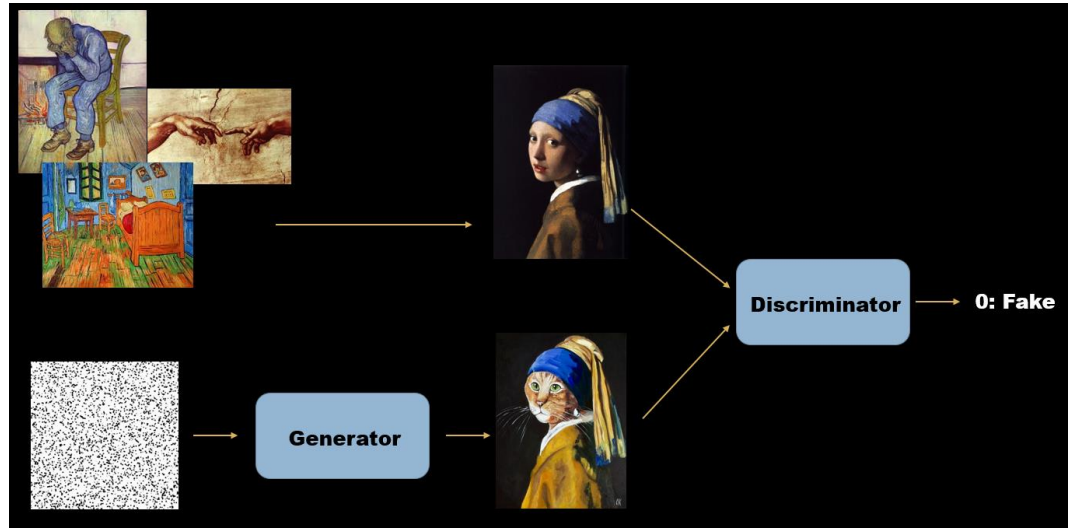
Diagnosis

Cancer is the 2nd cause of death[1]



> "*How can we train a neural network in order to accurately segment the skin cancer tissues when* ***very small amount of expert labelled data set is available*** *?*"

Generative Adversarial Networks (GANs)



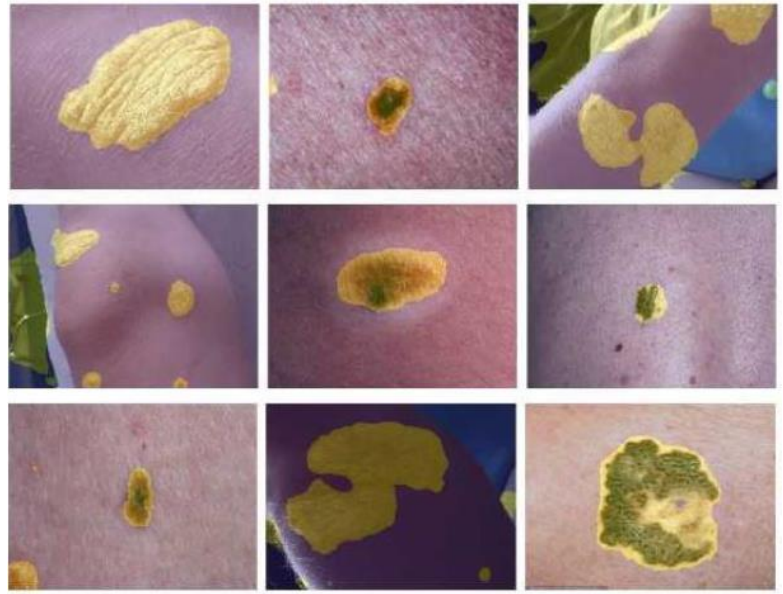
[1] World Health organization, http://www.who.int/news-room/fact-sheets/detail/cancer

Diagnosis

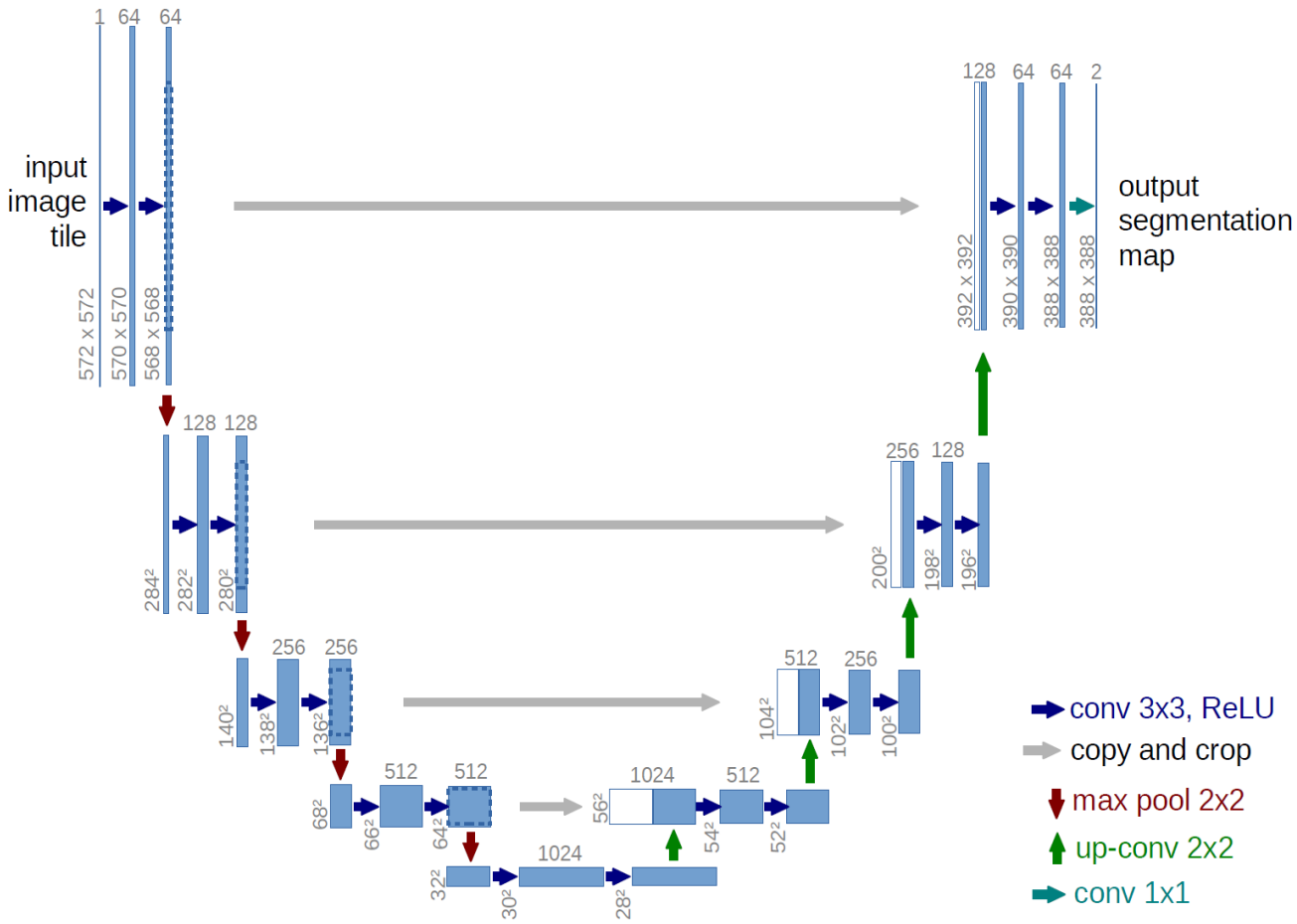
Generative Adversarial Networks (GANs)

41
expert
labelled
images

total 27336
number of labelled
images (virtual)

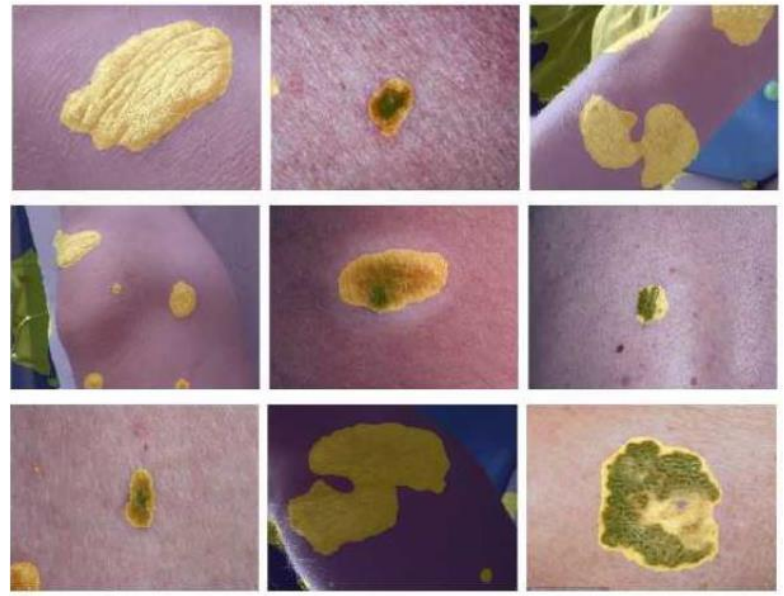


Diagnosis



U-Net

Transfer learning applied from VGG16



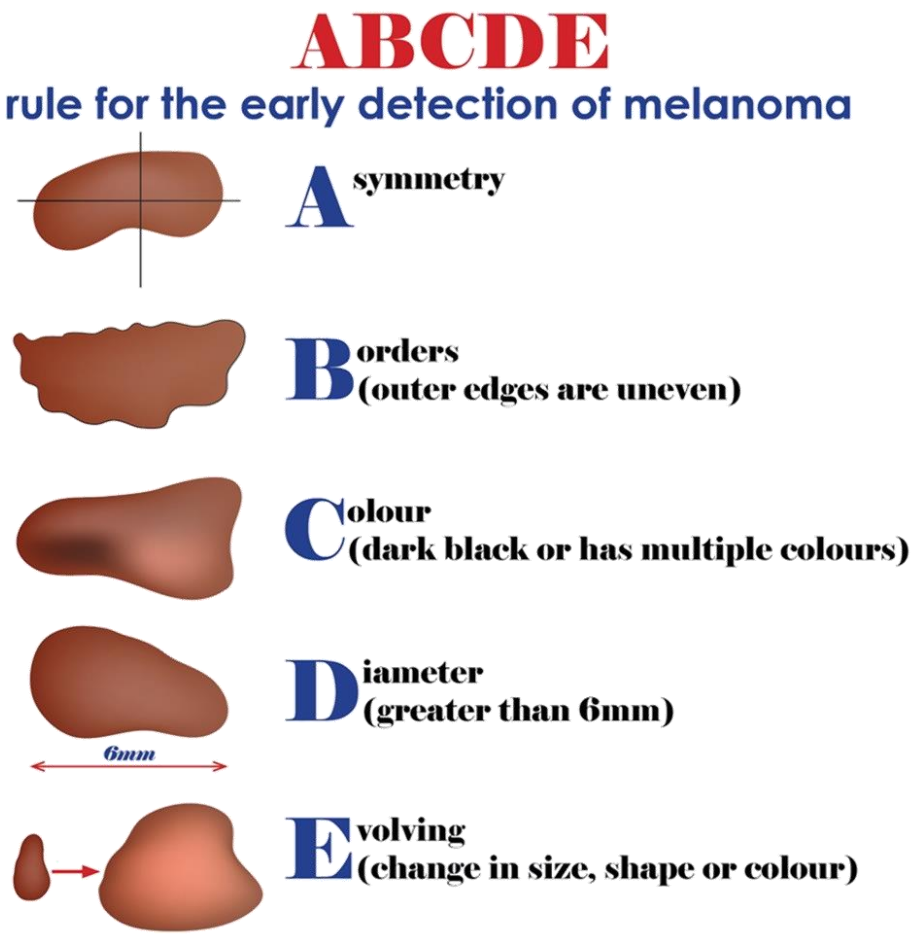
	Skin	Cancer
Skin	0.9598	0.0402
Cancer	0.0379	0.9621

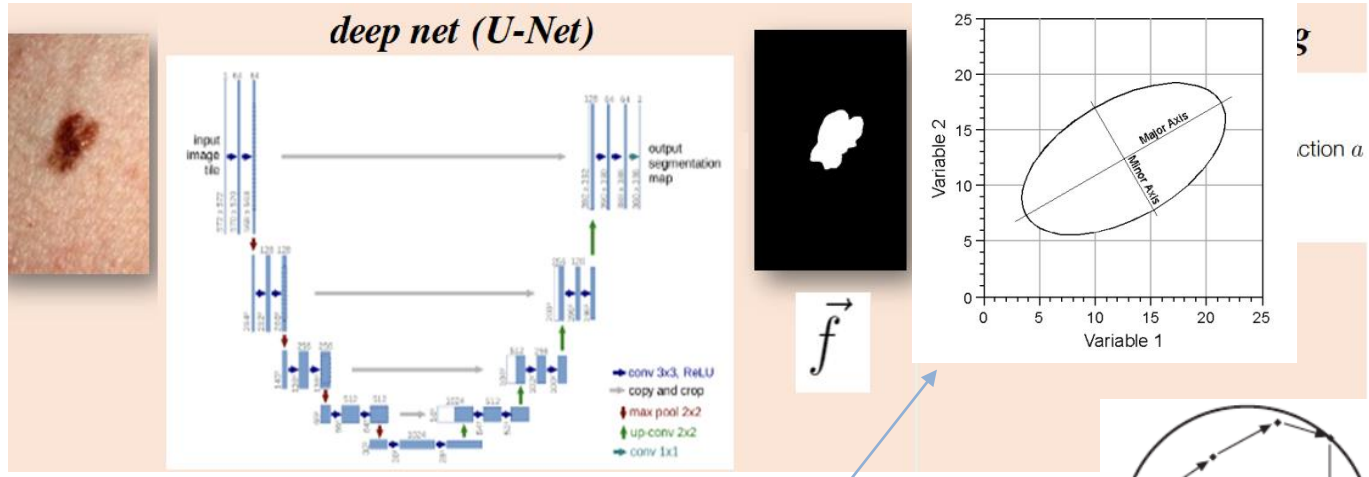
Confusion matrix shows the 96.21% success

Decision support

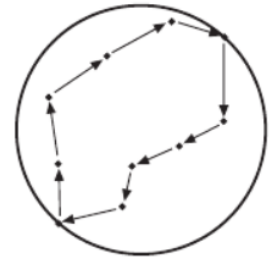
Reinforcement Learning

Decision support





	Method	Weight
A (Asymmetry)	PCA	w_a
B (Border)	Circularity	w_b
C (Color)	Color value	w_c
D (Diameter)	Circle diameter	w_d
E (Evolution)	Correlation	w_e



$$f = Aw_a + Bw_b + Cw_c + Dw_d + Ew_e$$

$$w_i = \frac{1}{T}\sum_{t=1}^{T} w_{i-1} v^{t-1}$$

Concluding Remarks

- Increase collaboration with AI community, Mechatronics and Robotics departments and Technical Medicine experts

- **Next step:** moving from translational medicine into real-world prototypes to be used at Radboud University Hospital

  - Further distribution of the product to other hospitals, leveraging student mobility for interdepartmental collaboration between Universities and hospitals