

Barclay's New Frontiers 2018

The InterContinental O2, London

Thursday 29th November 2018

Advancing an Age Old Industry

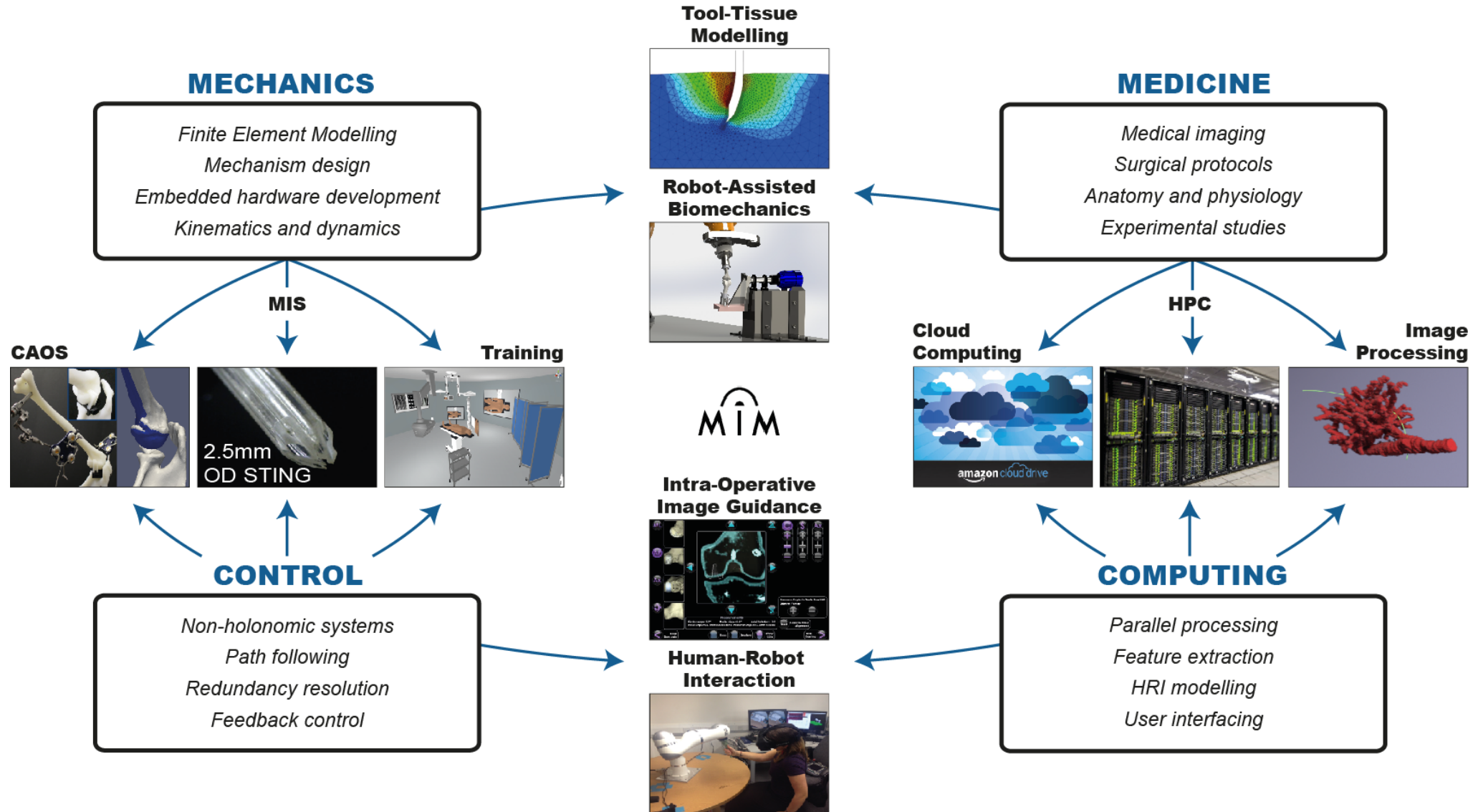
Ferdinando Rodriguez y Baena

Professor of Medical Robotics

Department of Mechanical Engineering

www.imperial.ac.uk/mechatronicsinmedicine

MIM Lab at a Glance



An Age Old Industry (that Changes Slowly...)

Blood Pressure Monitor



hce-uk.com

Stethoscope



littmann.com

Planning Acetates



Orthopaedic Surgical Tools



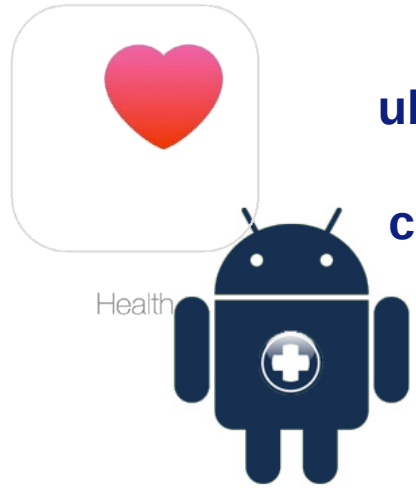
orthosupplier.com/players/images/mahe/product.jpg



Orthomedex

orthomedex.com/medicalpowertools_pricelist.html

On the Brink of Technology Revolution



ubiquitous
data
collection



unprecedented
machine
learning
abilities

NHS
Digital

70
YEARS
OF THE NHS
1948 - 2018



comprehensive
digitisation of healthcare



new
hardware
technologies

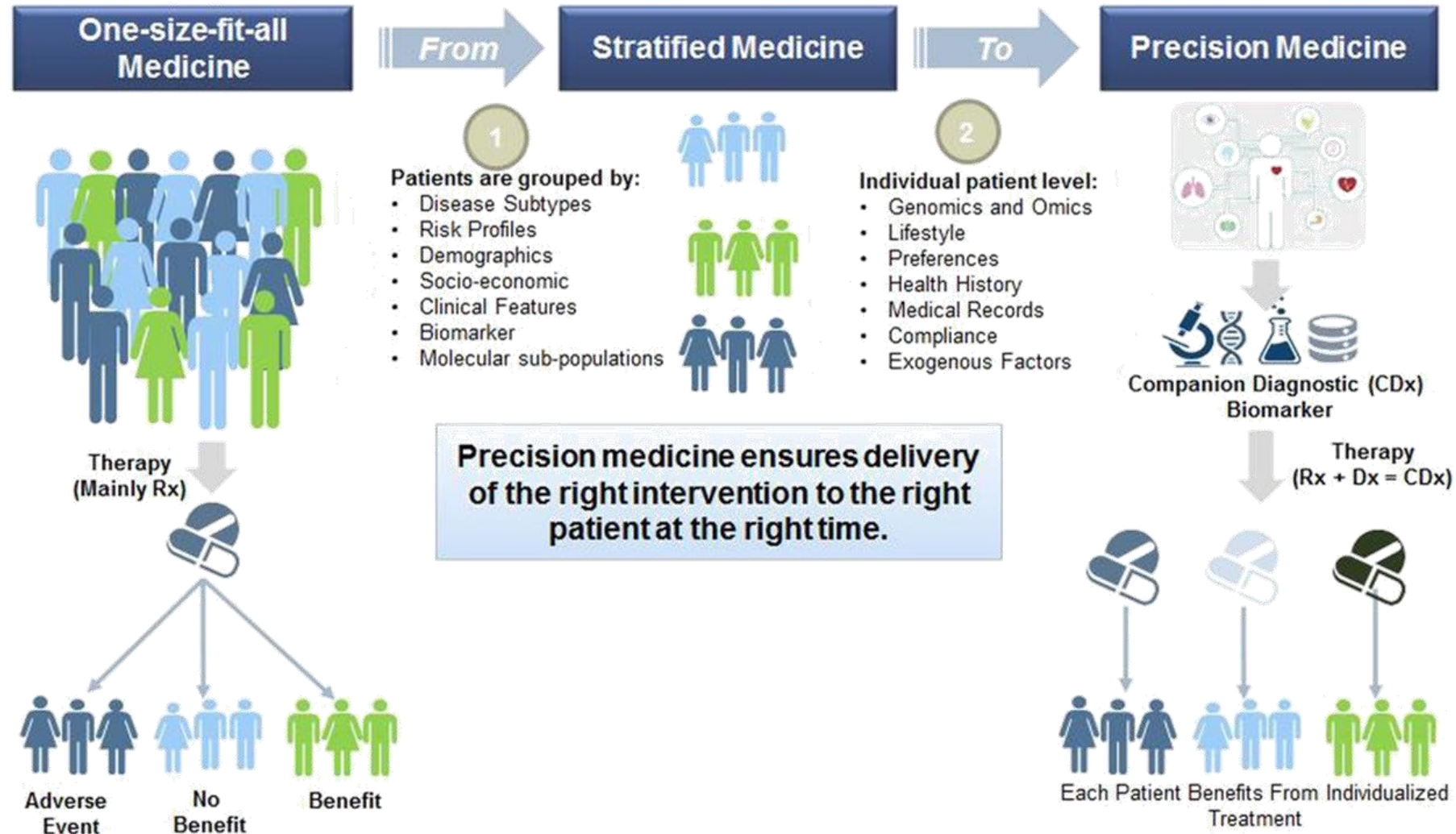


rocketing
computing
power



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From One Fits All to Personalised Healthcare



Technology for Healthy Living



garmin.com



apple.com



fitbit.com

regulatory hurdles



Medicines &
Healthcare products
Regulatory Agency



EUROPE



(Non-Sterile)
CLASS I
(Non-Measuring)



(Sterile)
CLASS I
(Measuring)



CLASS IIa



CLASS IIb



CLASS III

emergobyul.com



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Diagnostic Tech

acurable

WEARABLE MEDICAL DEVICES



Epilepsy



COPD



Asthma

affinity™



1 drop of blood

Haemoglobin

White blood cells

Platelets

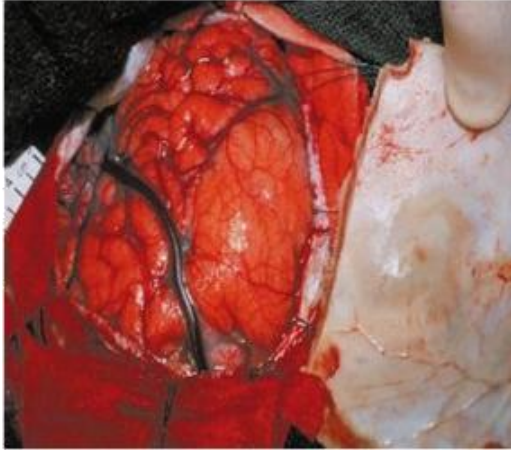


entia

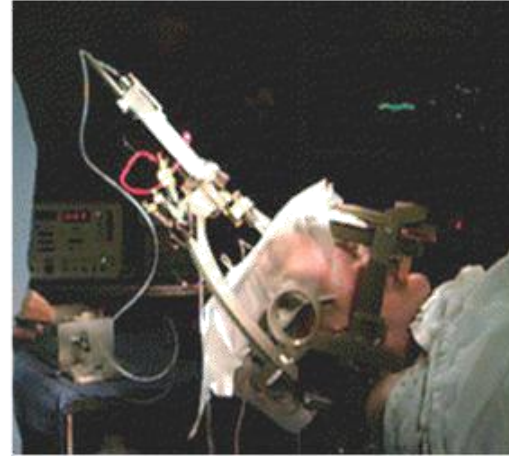
Low cost, simple-to-use blood tests

~~80%~~
99%
Treatment delayed
~~20%~~
1%

Technology in Surgery



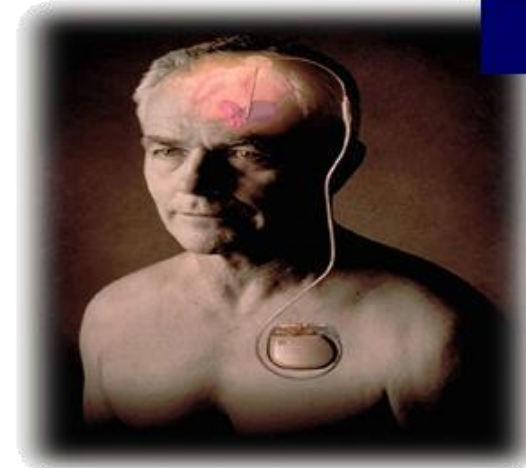
Conventional surgery



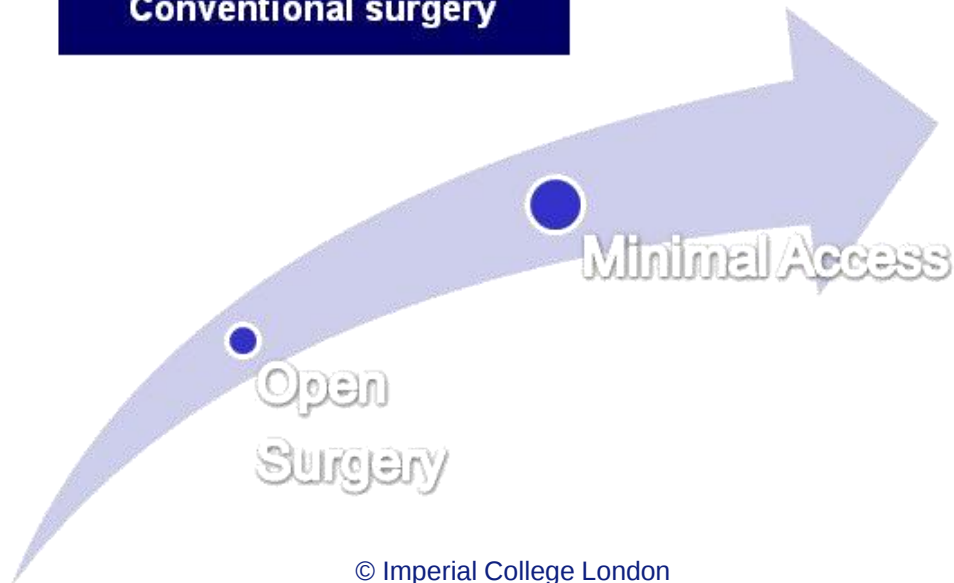
Neuroendoscopy



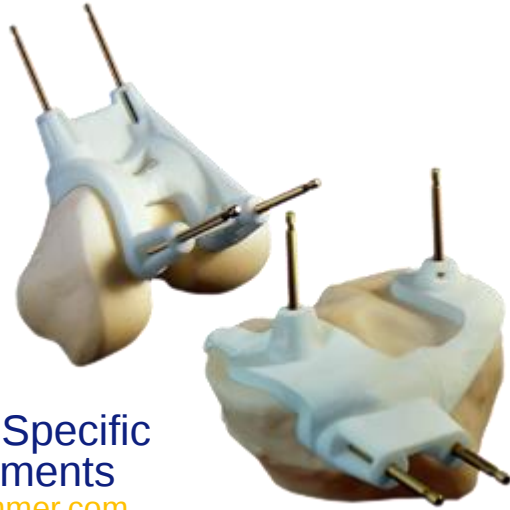
Microsurgery



Deep brain stimulation



Rapid Prototyping for Patient Specific Tools



Patient Specific
Instruments
www.zimmer.com



Signature
www.biomet.com



My Knee
www.medacta.com



iJig
www.conformis.com



ShapeMatch
www.stryker.com

- ✓ similar skin to skin times
- ✓ patient specific approach
- ✓ comparatively cheaper
- ✗ questionable accuracy
- ✗ large surgical access
- ✗ limited range of shape cuts

True Customisation in Surgery



Robotic Surgery

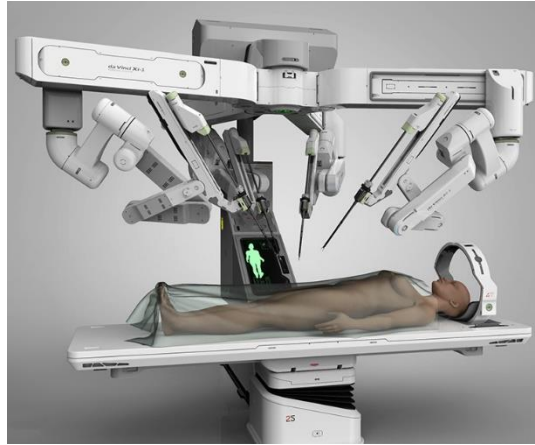
ACTIVE

ROBODOC
(www.robodoc.com)



MASTER-SLAVE

daVinci®
(www.intuitivesurgical.com)



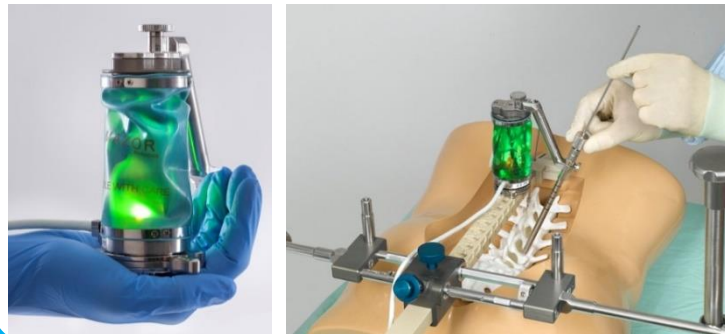
COOPERATIVE

RIO®
(www.makosurgical.com/)



PASSIVE

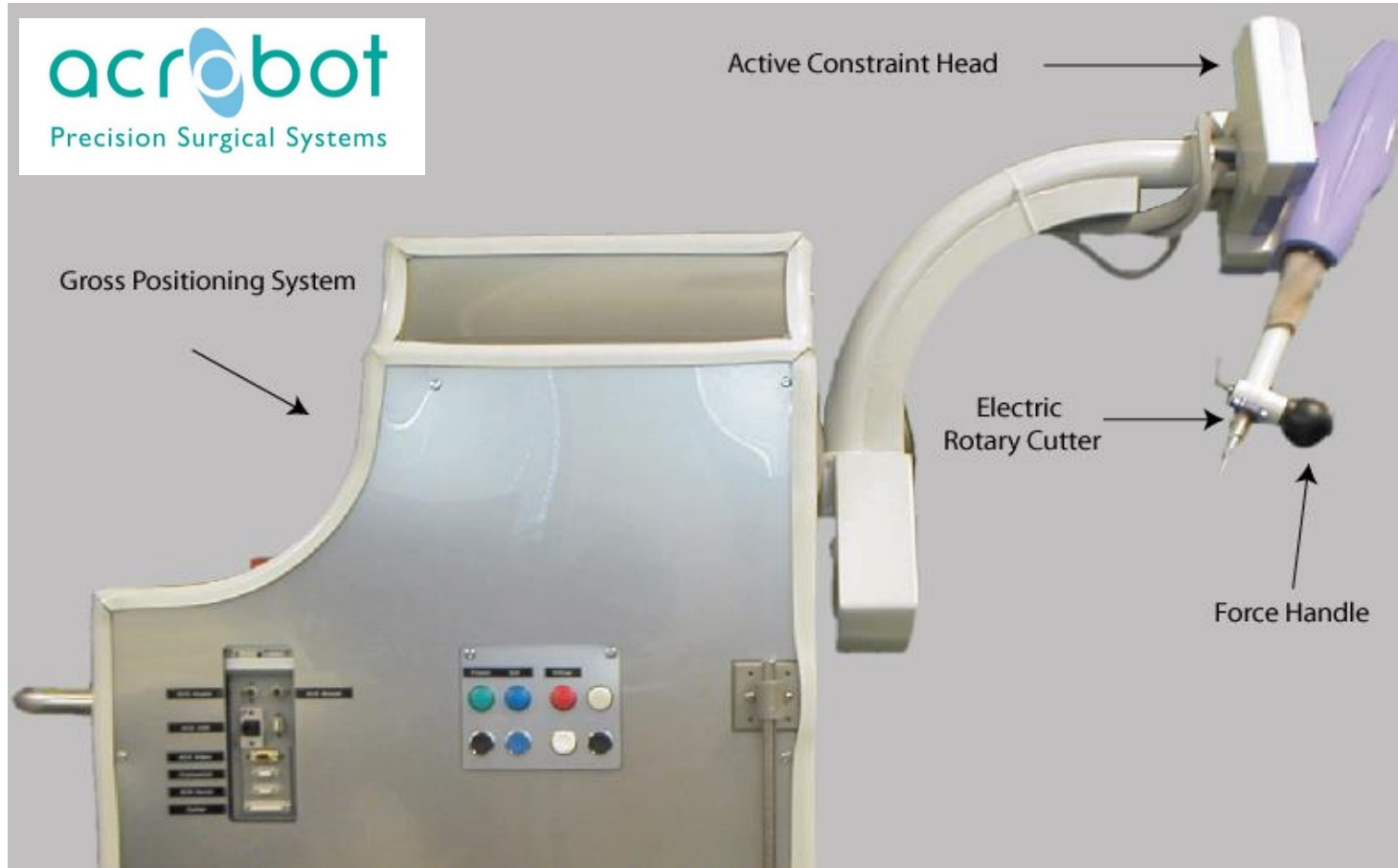
MAZOR Bone Mounted Robot
(www.mazorrobotics.com/)



NavioPFS®
(www.bluebelttech.com)



Hands-On Robotics for Surgery



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acrobot
Precision Surgical Systems

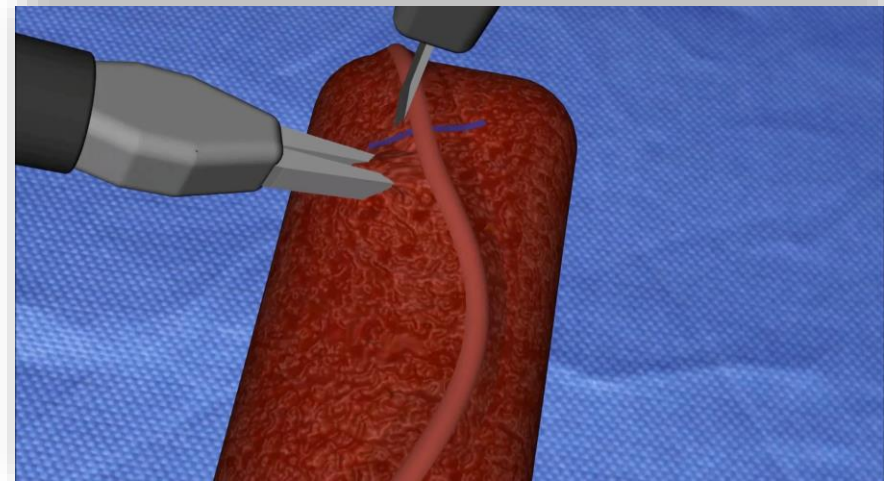
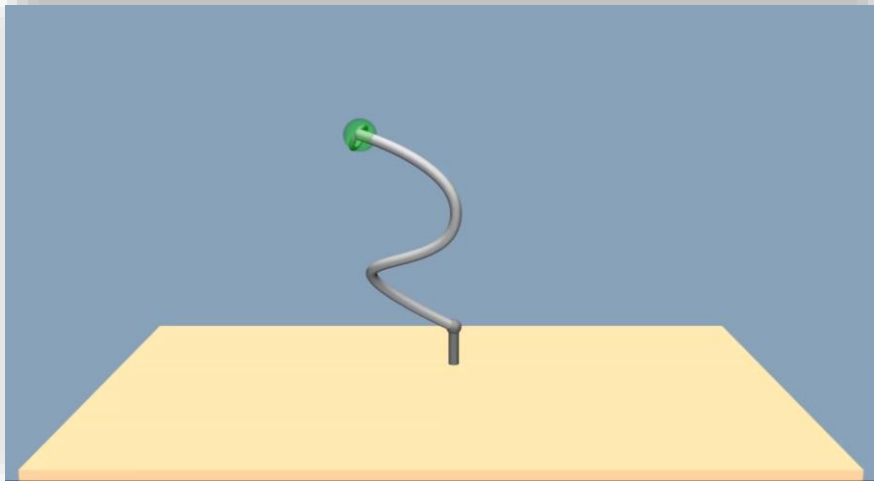
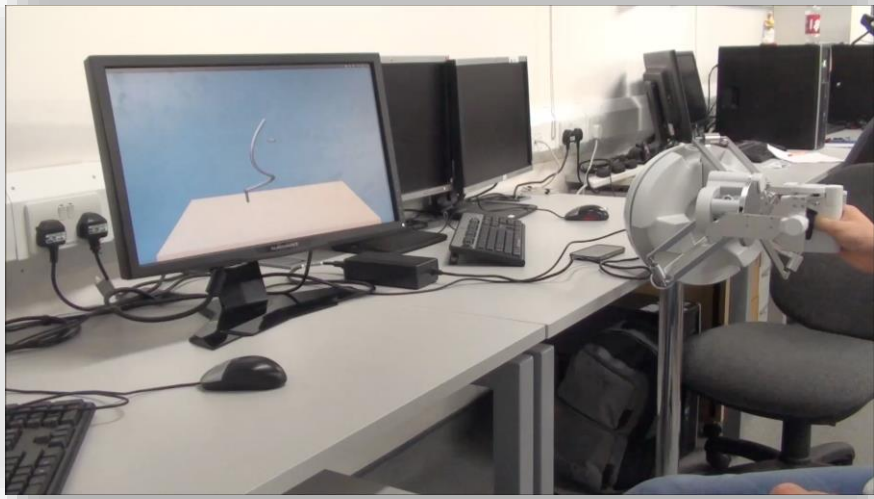
S Stanmore
Implants

MAKO
SURGICAL CORP.

stryker®

mim Imperial College
London

Robots Dealing with Soft Tissues



Bowyer and Rodriguez y Baena, "Dissipative control for physical human-robot interaction" (IEEE TRO 2015)

New Surgical Assistants



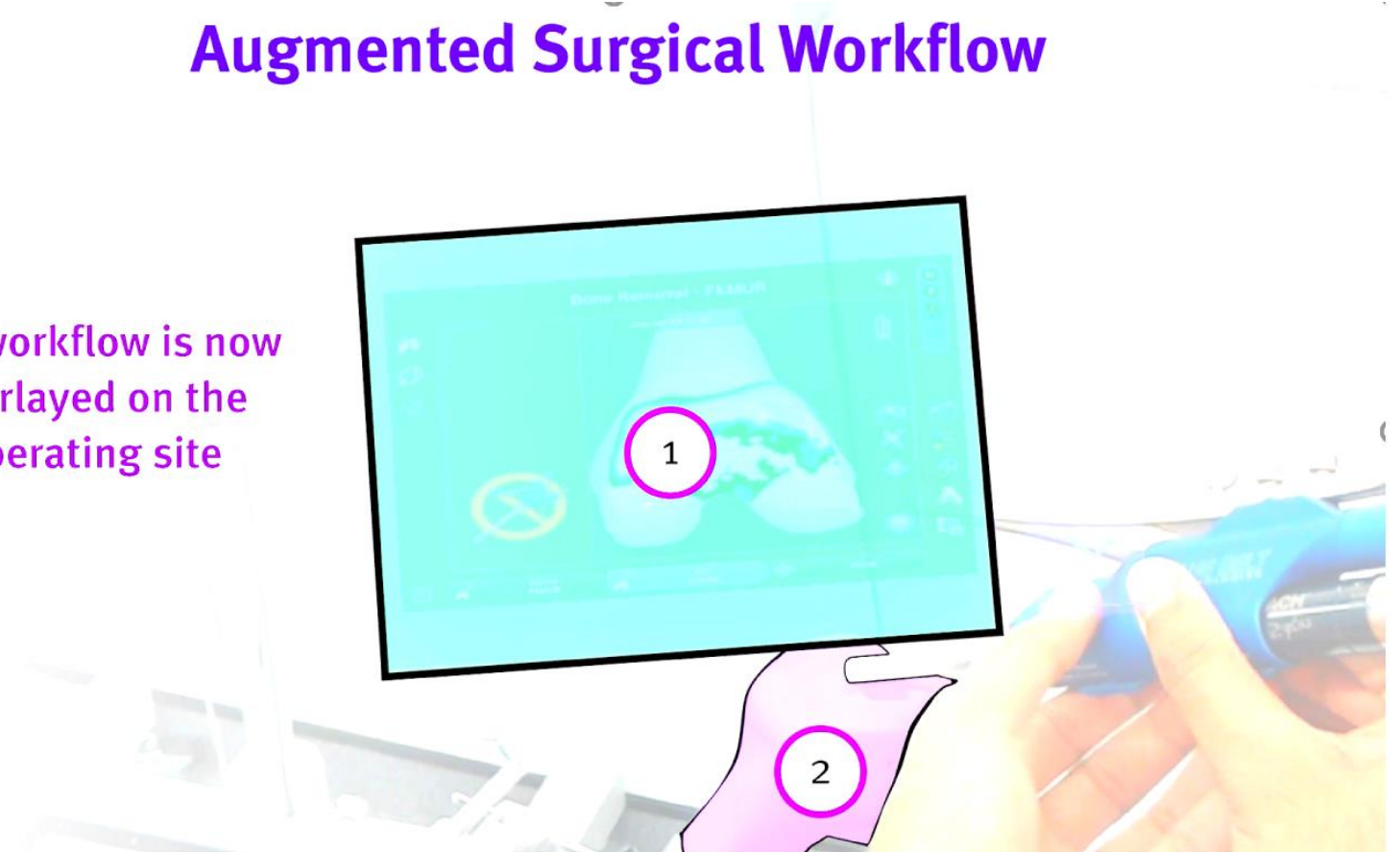
Liu et. al, "A Smart Registration Assistant for Joint Replacement: Concept Demonstration" (CAOS International 2017)

Augmented Reality for Better Immersion

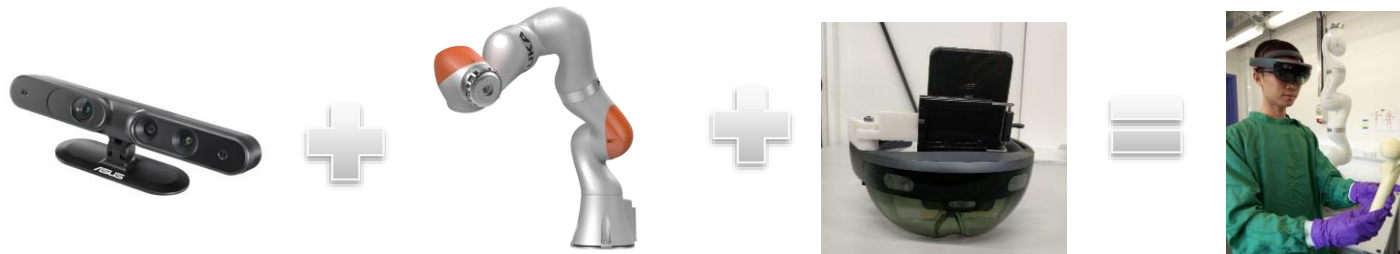
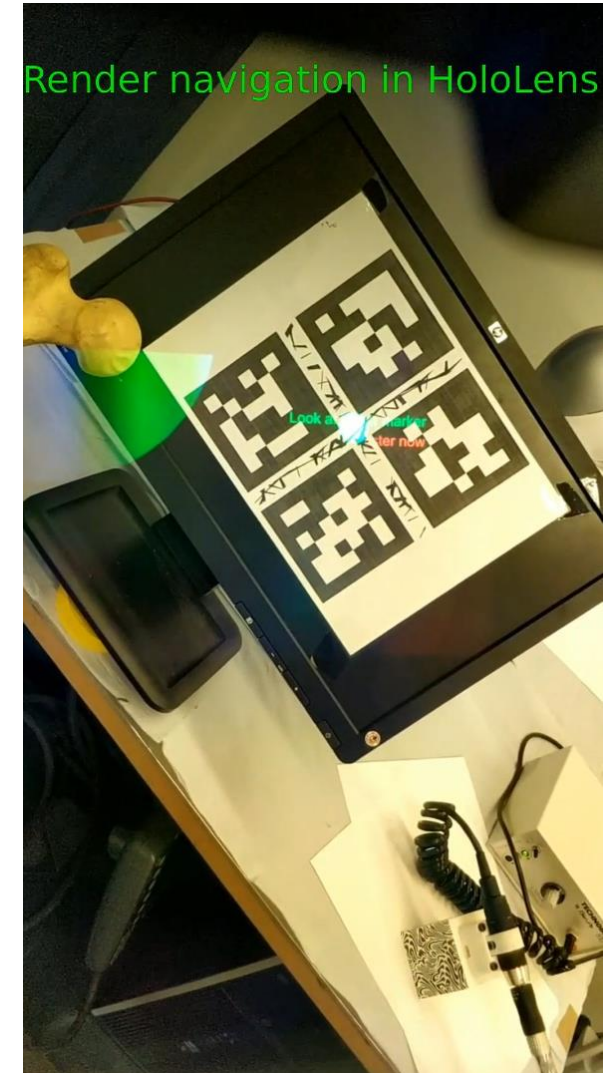
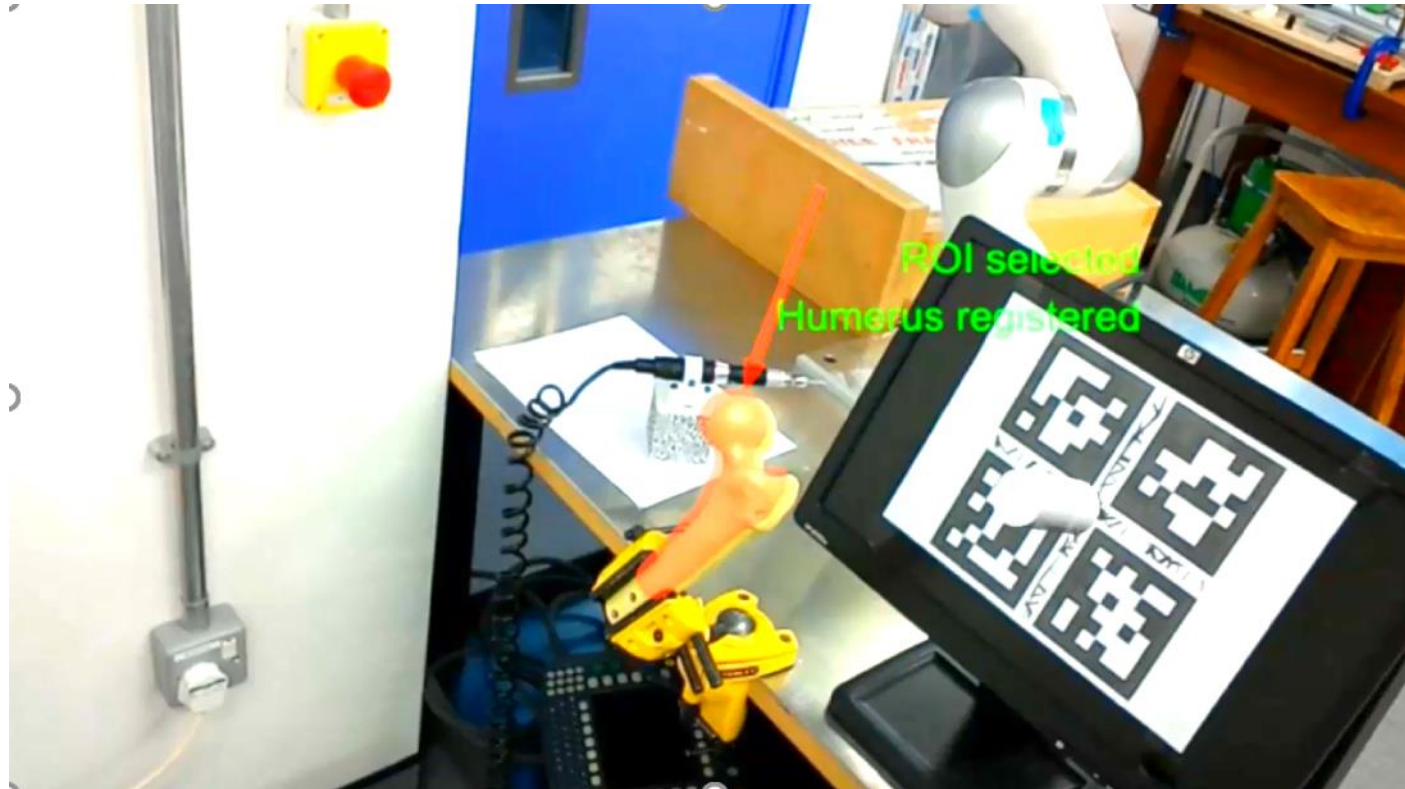


Augmented Surgical Workflow

The workflow is now
overlayed on the
operating site



Augmented Reality and New Workflows

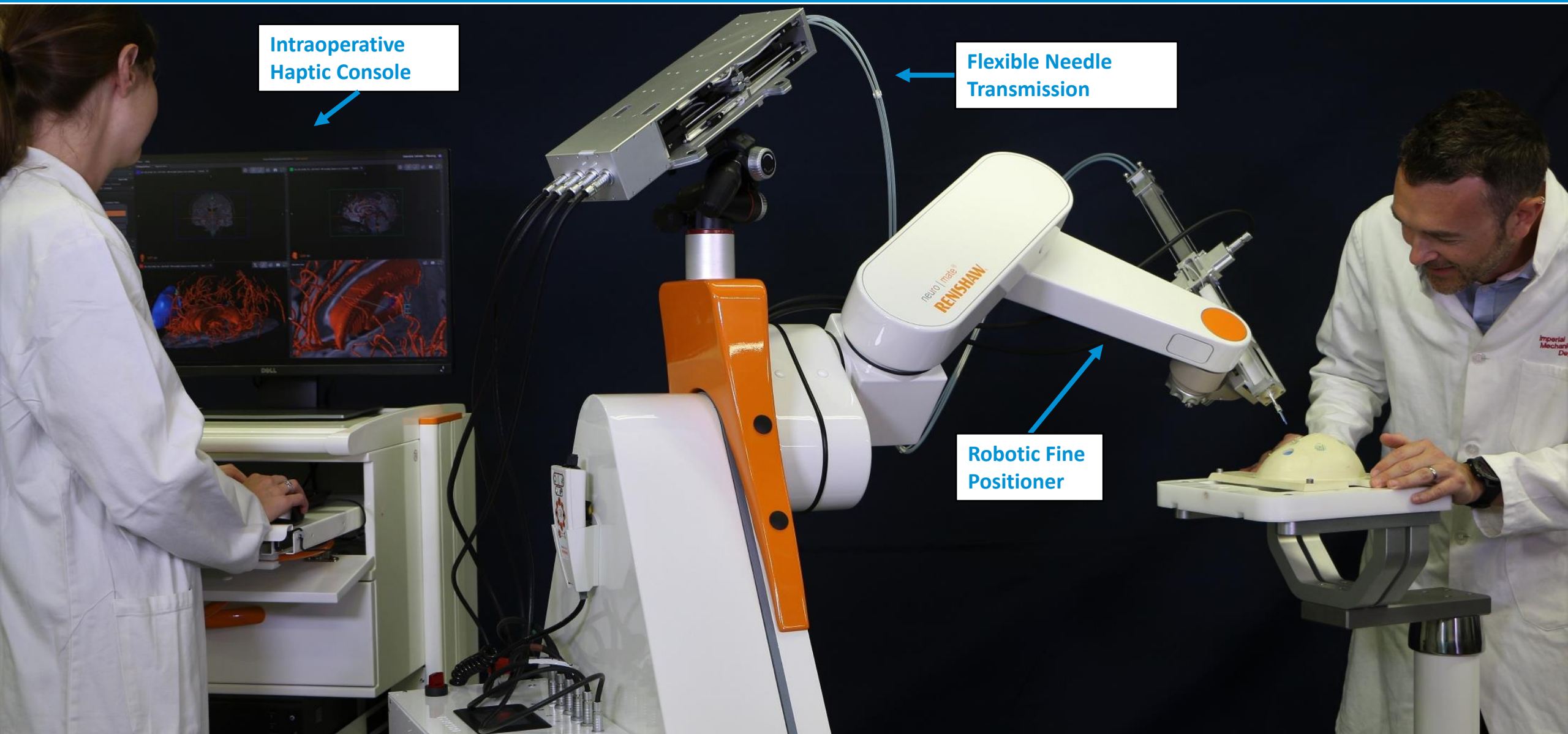


Liu et. al, "Augmented Reality Based Navigation for Computer Assisted Hip Resurfacing: A Proof of Concept Study" (ABME 2018)

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A Platform for Precision Neurosurgery





Intraoperative
Haptic Console

Flexible Needle
Transmission

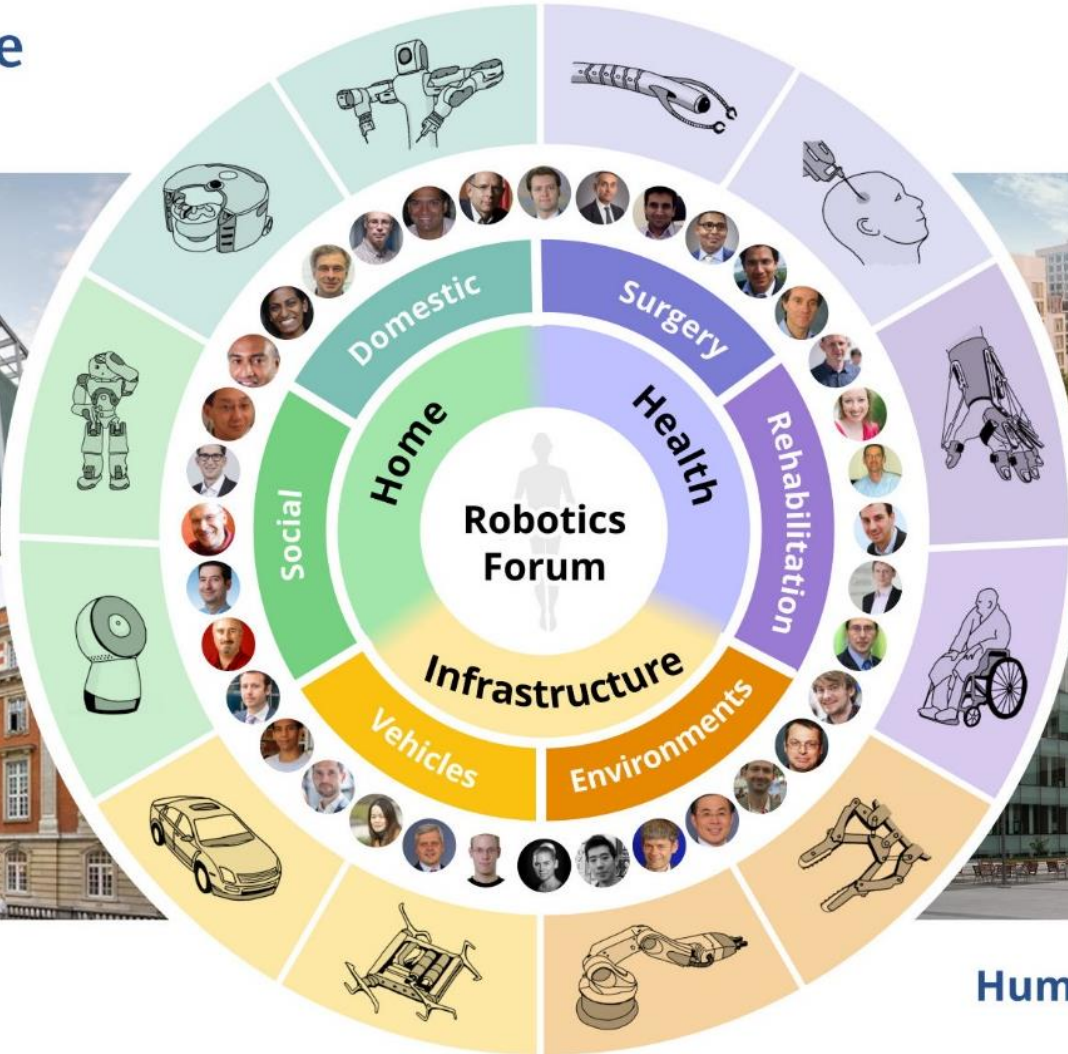
Robotic Fine
Positioner

So What Does the Future Hold?

- Software and hardware **power is rocketing**
- We are slowly **understanding how best to help**
- **Exciting technologies** on the horizon
 - Smarter, cheaper, smaller devices
 - Enhanced computational power (cloud computing, AI)
 - Enhanced visualization and immersion, e.g. AR
- **But...**
 - Certification route is still unclear and lagging behind
 - Med tech represents a patent litigation mine field... and there is GDPR to think about
 - Private/public healthcare route to entry is challenging

www.imperial.ac.uk/robotics

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Human Centred Robotics



PhD Students

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Vani Viridywan
He Liu
Marlene Pinzi
Eloise Matheson
Hisham Iqbal

Research Associates

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Dr Riccardo Secoli (H2020)
Dr Stefano Galvan (H2020)
Dr Hadi El Daou (EPSRC)
Dr Fabio Tatti (ImmpvateUK)
Dr Enrico Franco (EPSRC)

EngD Students

Arnau Garriga Casanovas
(Rolls Royce)



Thank you.