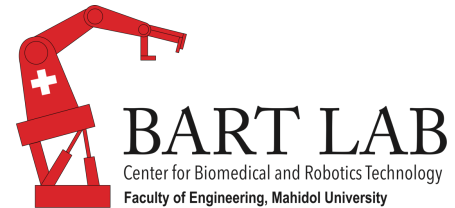**Mahidol University**
Wisdom of the Land
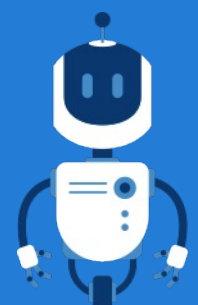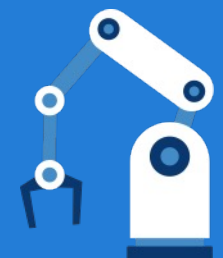
Mahidol University
Faculty of Engineering

BART LAB
Center for Biomedical and Robotics Technology
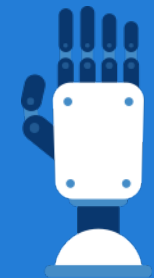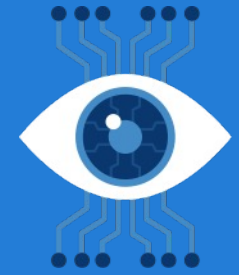**Faculty of Engineering, Mahidol University**
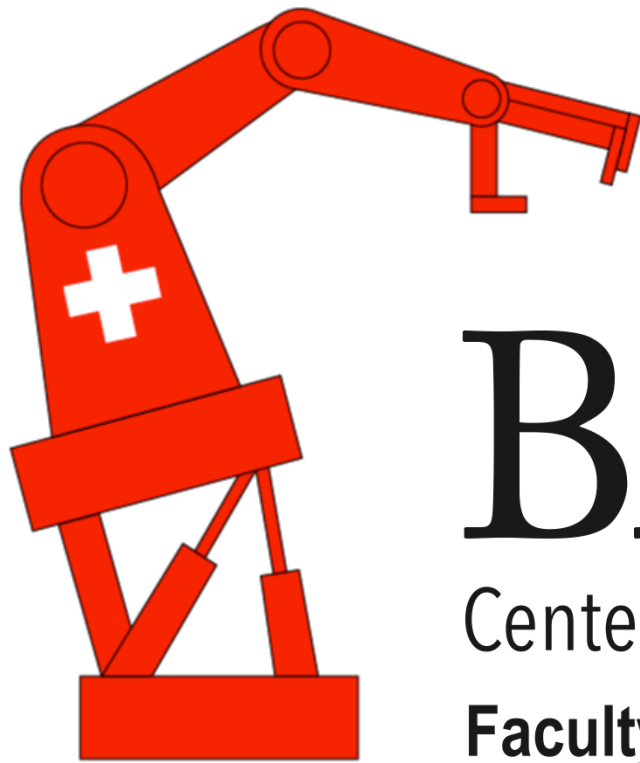
Medical Robotics

BART LAB @Mahidol Engineering

Jackrit Suthakorn, PhD

รศ.ดร.จักรกฤษณ์ ศุทธากรณ์
Founder, Department of Biomedical Engineering,
Founder, Center for Biomedical and Robotics Technology (BART LAB)
Faculty of Engineering, Mahidol University.

BART LAB

Center for Biomedical and Robotics Technology

Faculty of Engineering, Mahidol University

Safety and Standardization
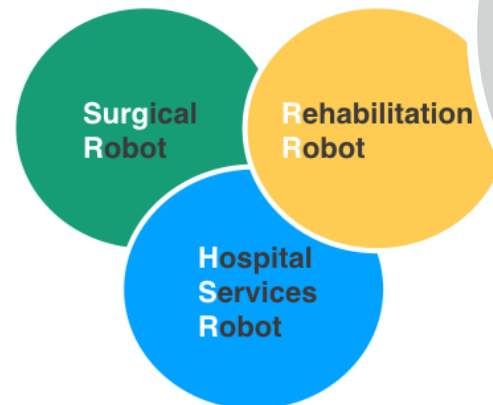
Need from Hospital and Medicines

Medical Application

Robotics

Electronics + Controls

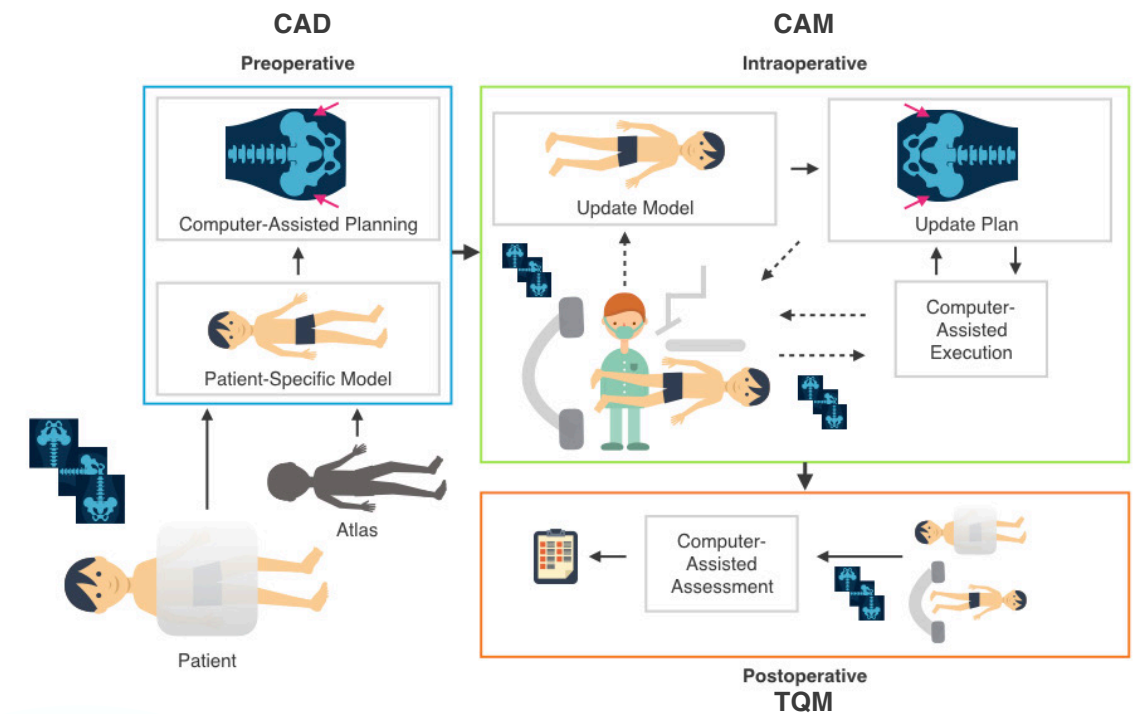Mechanical Design + Mechanism

Computer Program + AI

CAD
Preoperative

Computer-Assisted Planning

Patient-Specific Model

Atlas

Patient

CAM
Intraoperative

Update Model

Update Plan

Computer-Assisted Execution

Computer-Assisted Assessment

Postoperative
TQM

Architecture of a surgical CAD/CAM system

Medical Robotics

Surgical Robot

Rehabilitation Robot

Hospital Services Robot

Computer Integrated Surgery

Human Interactive Robot

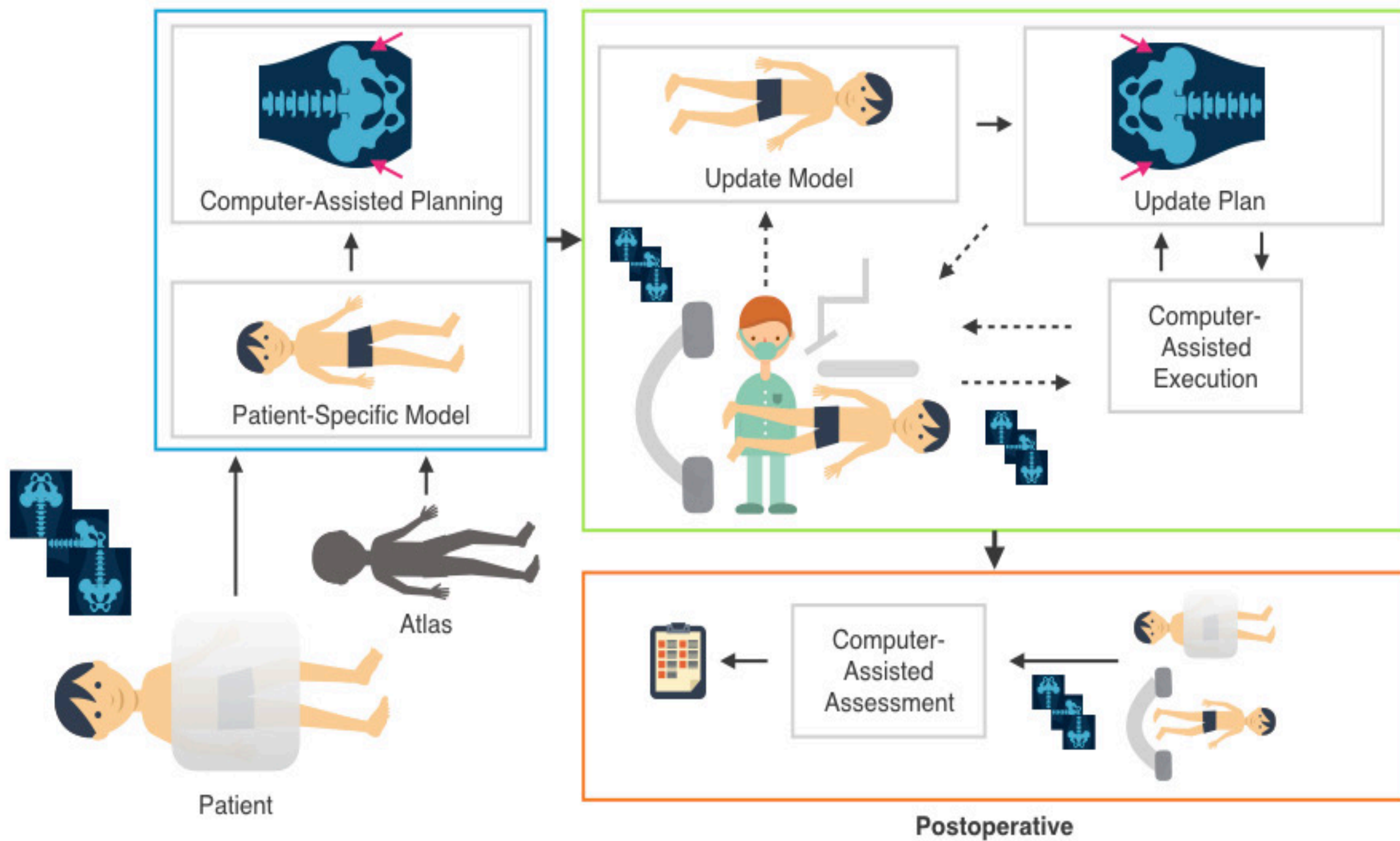**Human Robot Interface**

Performance Robot for Human Assistance

Robot Compatible Environment

CAD

CAM

Preoperative

Intraoperative

Computer-Assisted Planning

Patient-Specific Model

Atlas

Patient

Update Model

Update Plan

Computer-Assisted Execution

Postoperative

Computer-Assisted Assessment
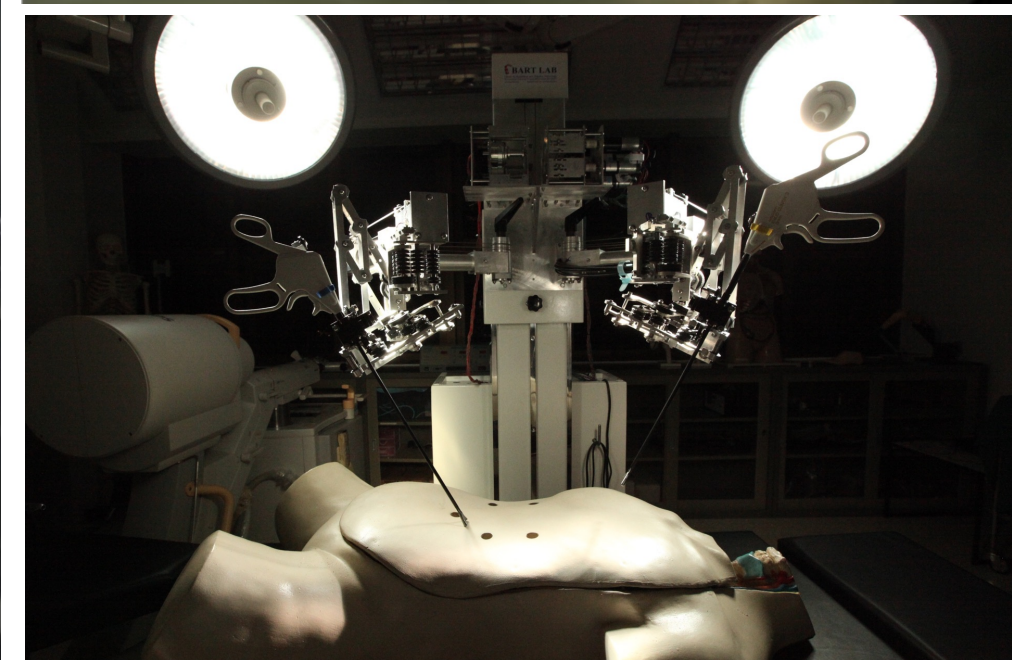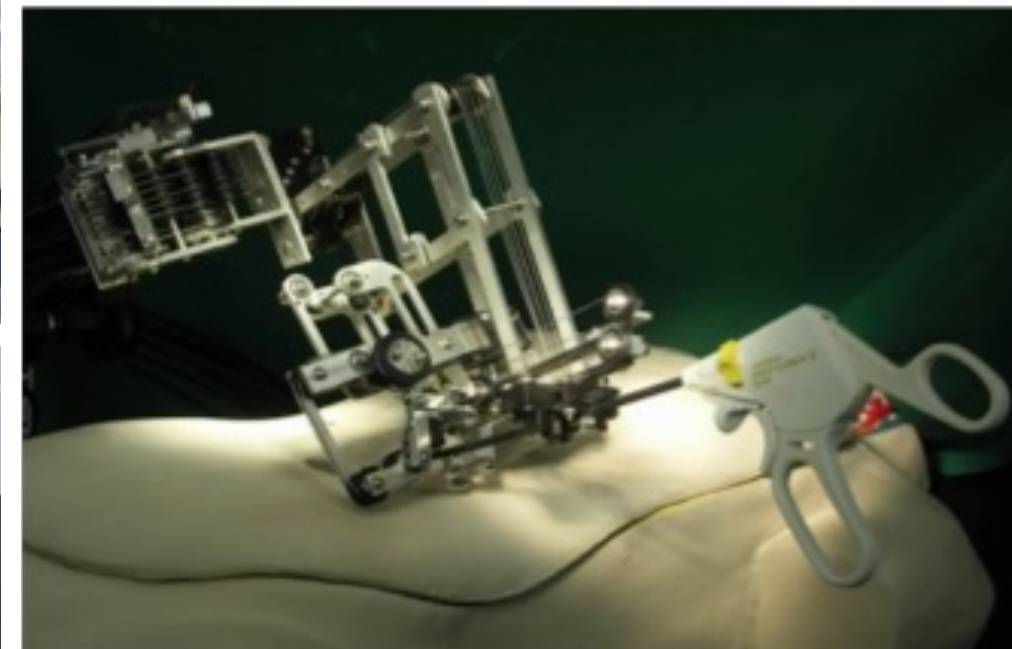
TQM

MU-Laparobot: A Corporative Surgical Robot for Laparoscopic Surgery

Jackrit Suthakorn[1], Chumpon Wilasrussamee, MD[2], Chawaphol Direkwattana[1], Nantida Nillahoot[1], Saqib Hussain Shah[1], Yuttana Israchaiyos[1], Pittawat Thiutipsakul[1]
[1]BART LAB, Faculty of Engineering, Mahidol University,
[2]Department of Surgery, Faculty of Medicine Ramathibodi Hospital, Mahidol University

• Direkwattana, C., Suthakorn, J. and Wilasrussamee, "Mu-laparobot: A Corporative Surgical Robot for Laparoscopic Surgery," The Open Biomedical Engineering Journal, 2020, Vol. 14(1), pp. 43-53.
• Pillai, B., M., Wilasrussamee, C., and Suthakorn, J., "Observer Based Dynamic Control Model for Bilaterally Controlled MU-Laparobot: Surgical Tool Force Limiting," *International Journal of Electrical and Computer Engineering*, Vol. 10(1), 2020, pp. 828-839.

Medical Robotics
Surgical Robotics

SurgySim: A Virtual Reality Laparoscopic Surgical Training with Haptic Feature

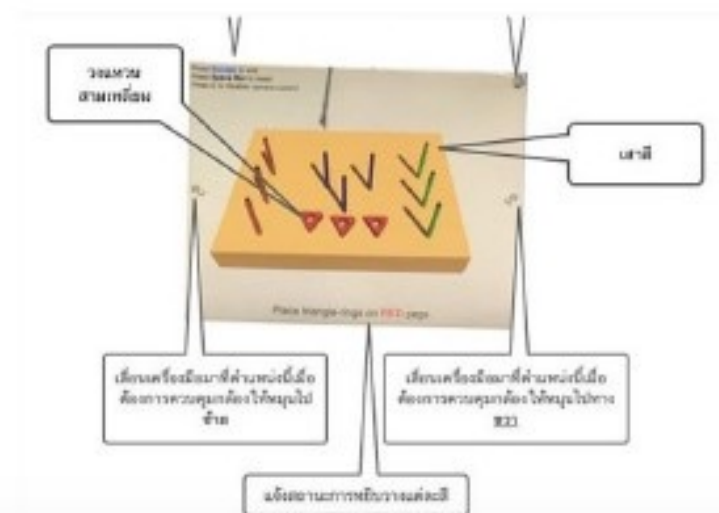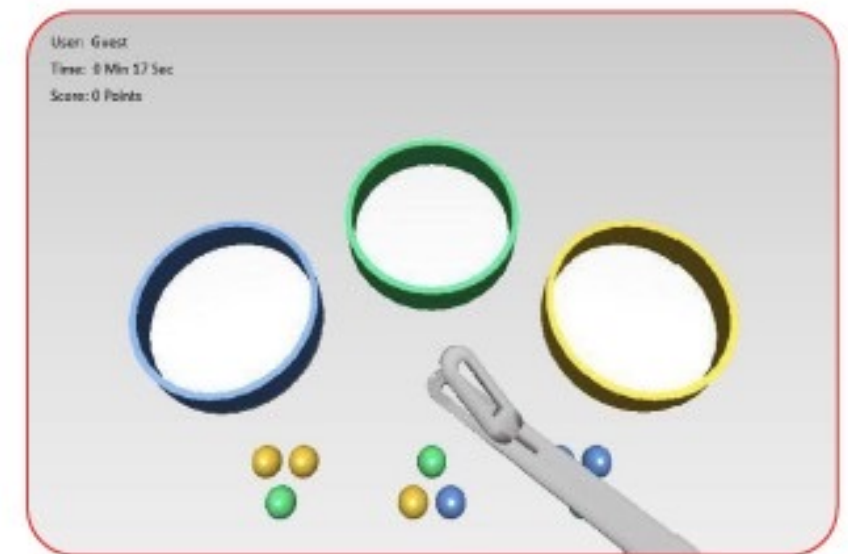Jackrit Suthakorn[1], Chumpon Wilasrusmee, MD[2], Nantida Nillahoot[1], Branesh Pillai[1]
[1]BART LAB, Faculty of Engineering, Mahidol University,
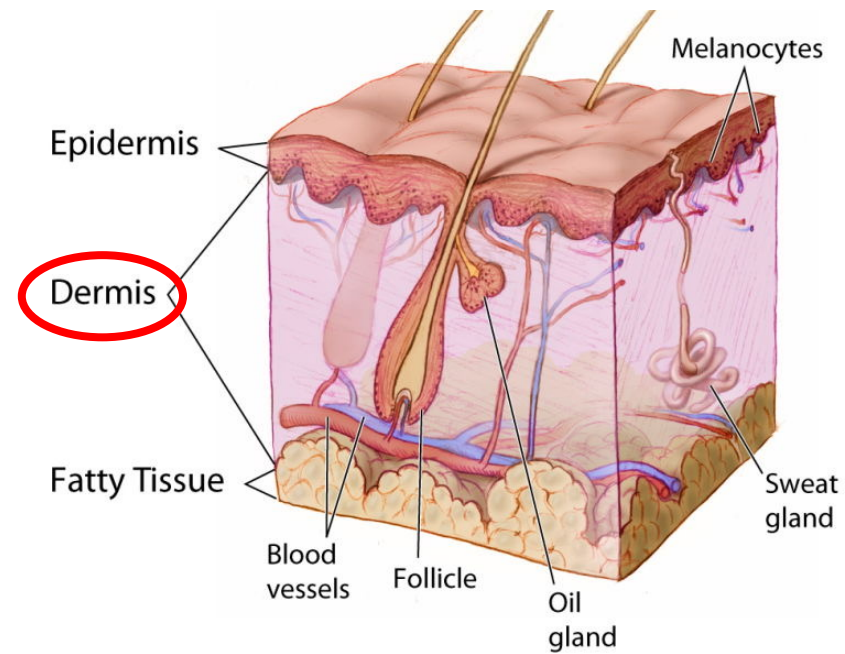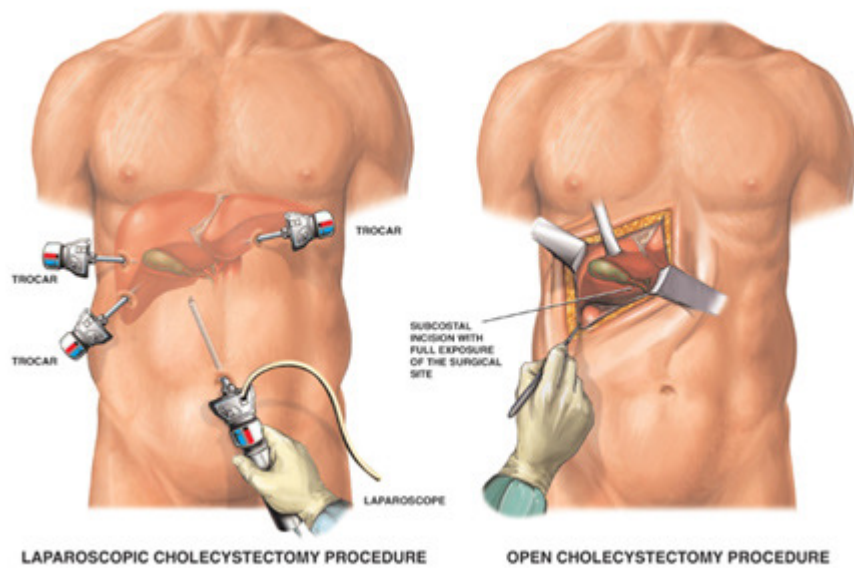[2]Department of Surgery, Faculty of Medicine Ramathibodi Hospital, Mahidol University

• Nillahoot, N., Patel, S., Wilasrussamee, C., and Suthakorn, J., "A Technique for Mimicking Soft Tissue Manipulation from Experimental Data to A Wave Equation Model for A New Laparoscopic Virtual Reality Training System," *The Open Biomedical Engineering Journal, 2021, Vol. 15(1), pp. 03-15.*
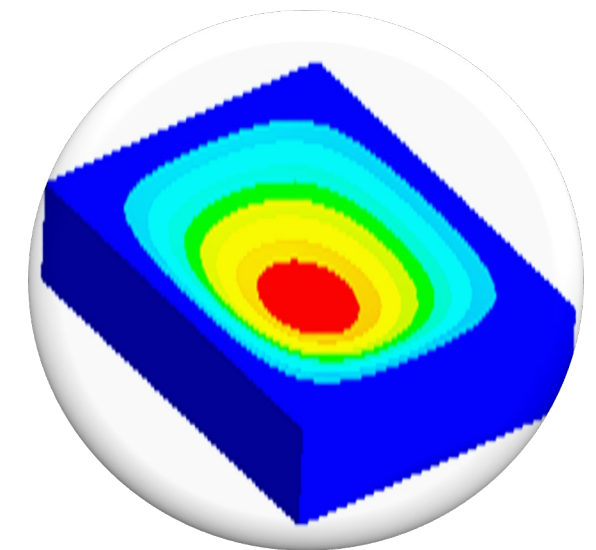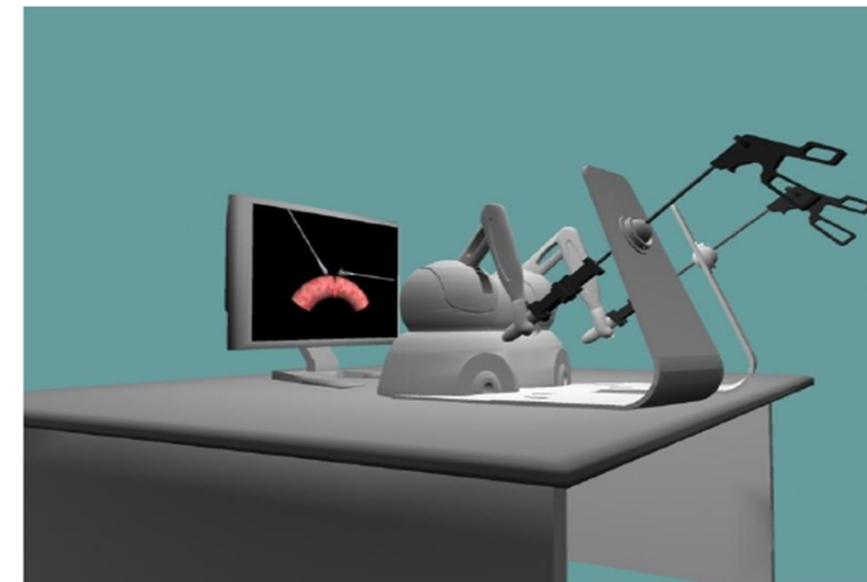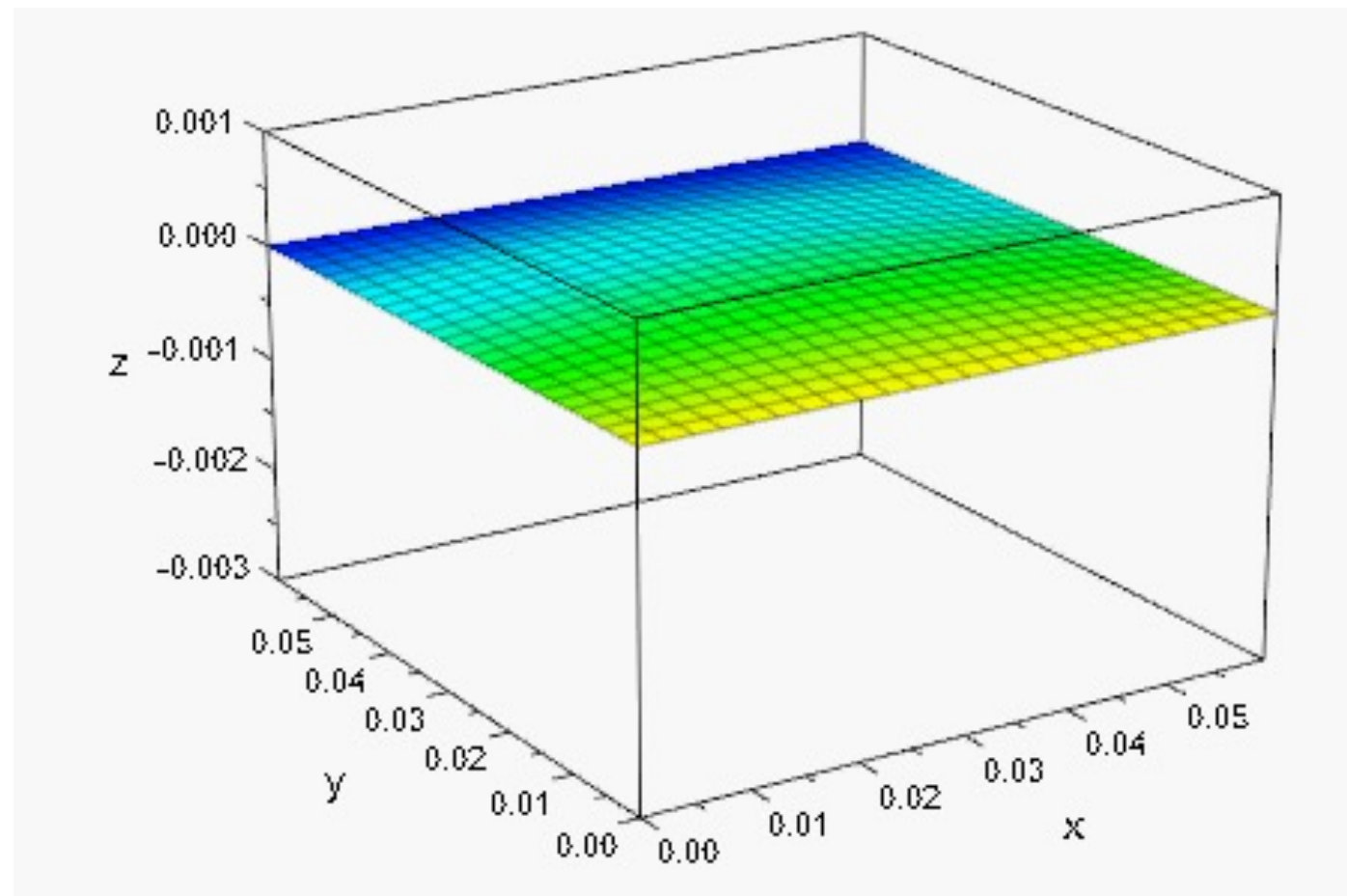
Medical Robotics
Surgical Robot

Problem Statement

LAPAROSCOPIC CHOLECYSTECTOMY PROCEDURE

OPEN CHOLECYSTECTOMY PROCEDURE

Epidermis

Dermis

Fatty Tissue

Blood vessels

Follicle

Oil gland

Sweat gland

Melanocytes

Constructing a Heterogeneous Model for Soft Tissue Deformation Using Two Dimensional Wave Equations

Under Collaboration with Ramathibodi Hospital

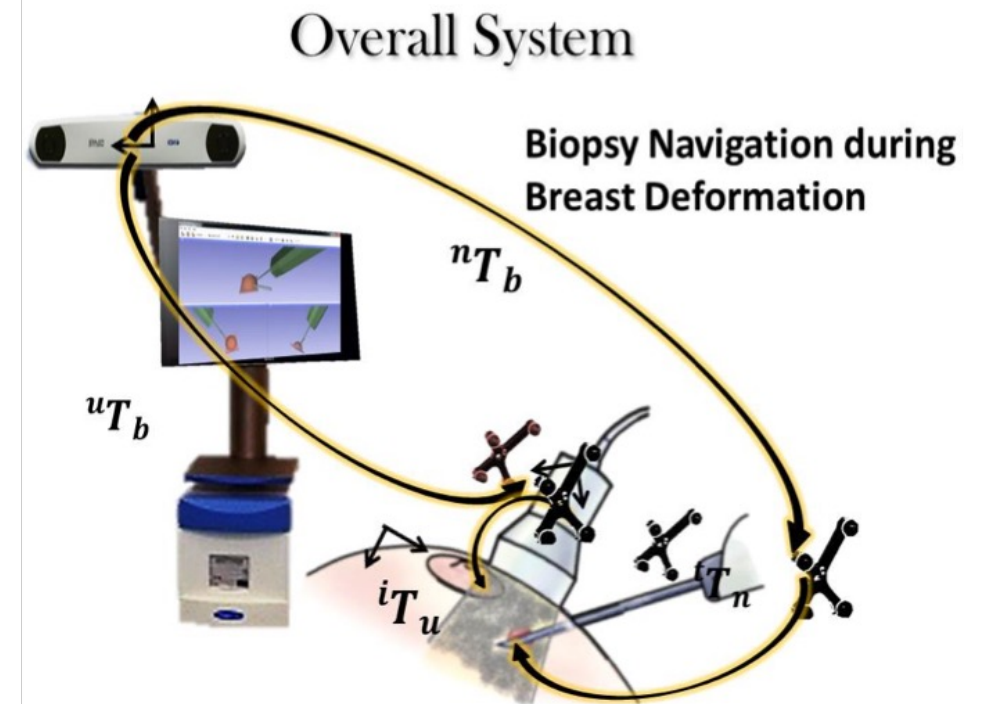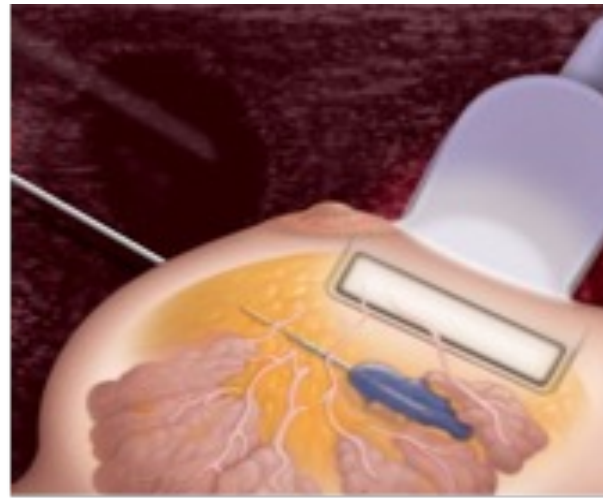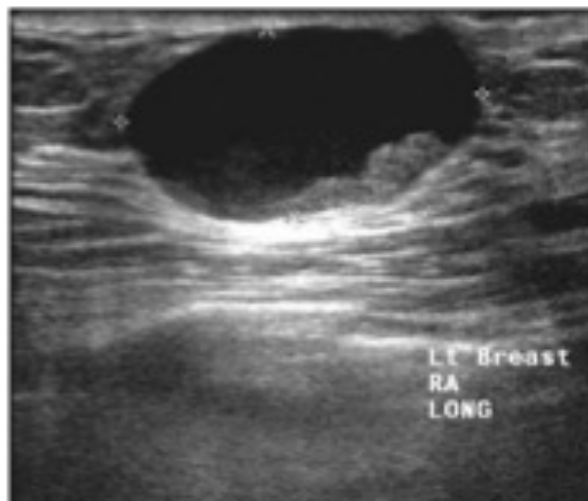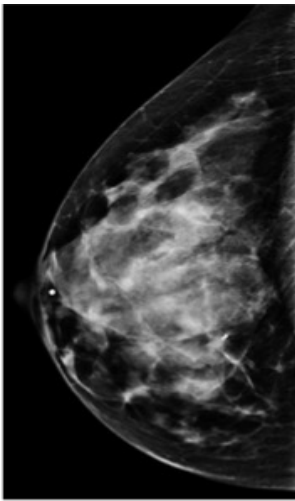# Computer-Integrated Surgical System for Breast Biopsy

Jackrit Suthakorn[1], Cholatip Wiratkapan, MD[2], Songpol Ongwattanakul[1], Maria Chatrasingh[1], Narucha Tanaiutchawoot[1], Bantita Treepong[1]
[1]BART LAB, Faculty of Engineering, Mahidol University,
[2]Department of Radiology, Faculty of Medicine Ramathibodi Hospital, Mahidol University

Overall System

Biopsy Navigation during Breast Deformation

^nT_b

^uT_b

^iT_u

^nT_n

ULTRASOUND CALIBRATION TOOLKIT

- Suthakorn, J., Tanaiutchawoot, N., and Wiratkapan, C., "Ultrasound calibration with ladder phantom at multiple depths for breast biopsy navigation system," *Theoretical and Applied Mechanics Letters*, 2020, Vol. 10 (5), pp. 343-353.
- Suthakorn, J., Tanaiutchawoot, N., Wiratkapan, C., and Ongwattanakul, S. "Breast Biopsy Navigation System with an Assisted Needle Holder Tool and 2D Graphical User Interface," *European Journal of Radiology Open, Vol. 5, 2018, pp. 93-101.*
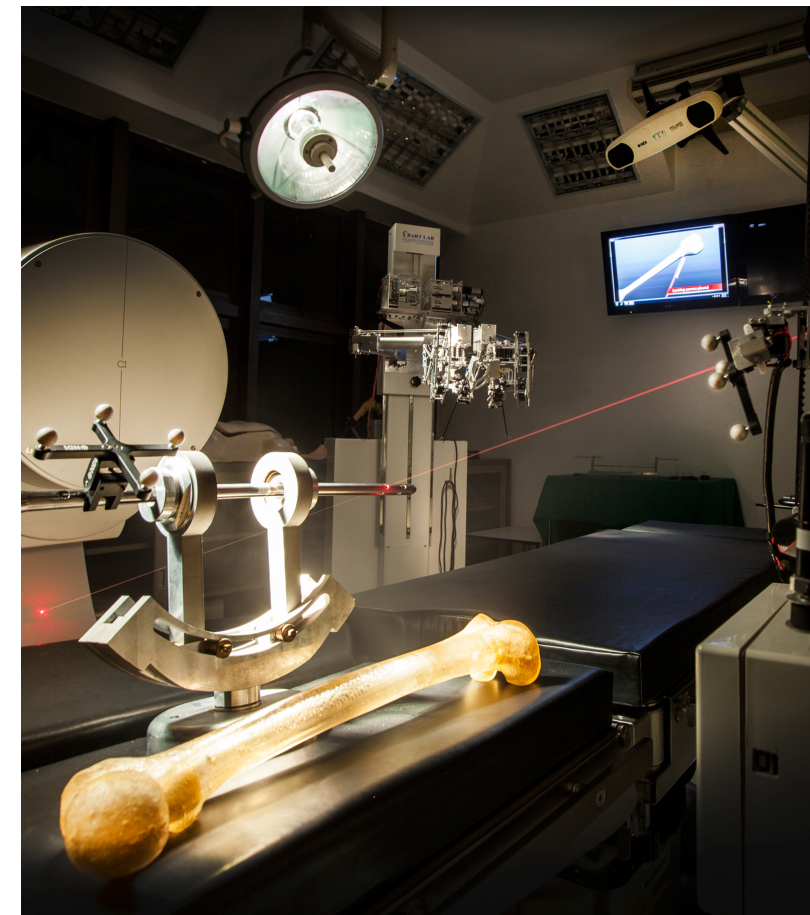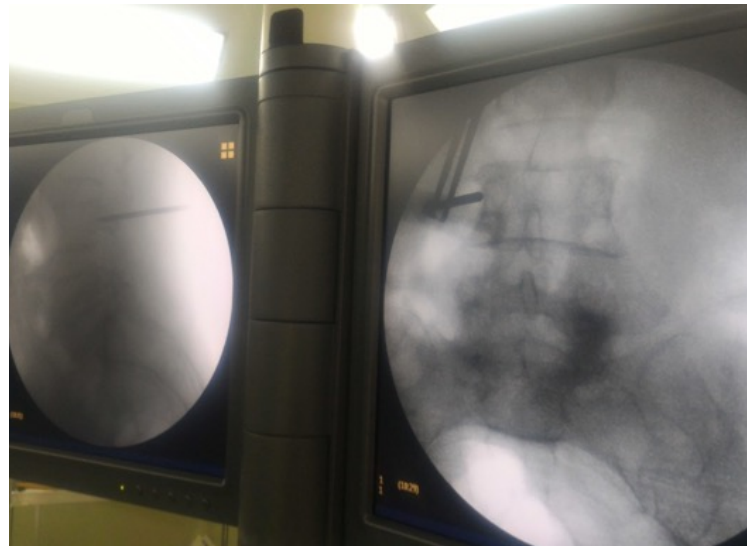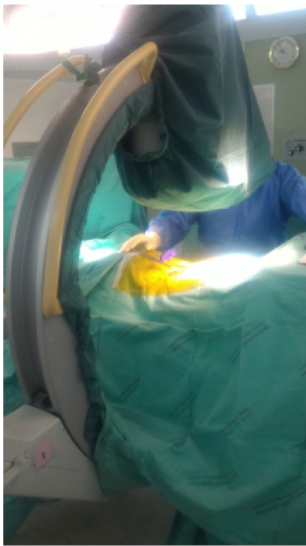
Medical Robotics
Surgical Robotics

ORTHOBOT: Percutaneous Pedicle Screw Insertion

Jackrit Suthakorn[1], Areesak Chotvichit, MD[2], Sakol Nakdhamabhorn[1]
[1]BART LAB, Faculty of Engineering, Mahidol University,
[2]Department of Orthopeadic Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University

Endonasal Endoscopic Transsphenoidal Surgical Robot

Jackrit Suthakorn[1], Sorayouth Chamnanvej, MD[2], Suvipat Chalongwonge[1], Branesh Pillai[1]
[1]BART LAB, Faculty of Engineering, Mahidol University,
[2]Department of Surgery, Faculty of Medicine Ramathibodi Hospital, Mahidol University
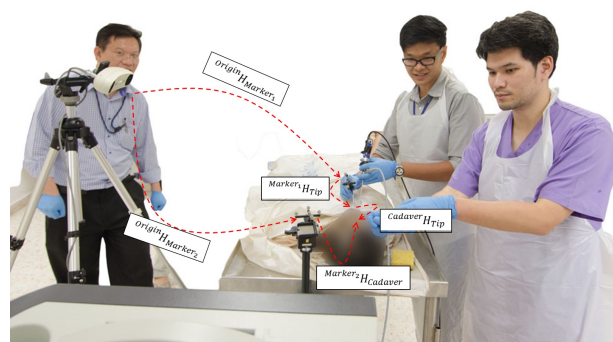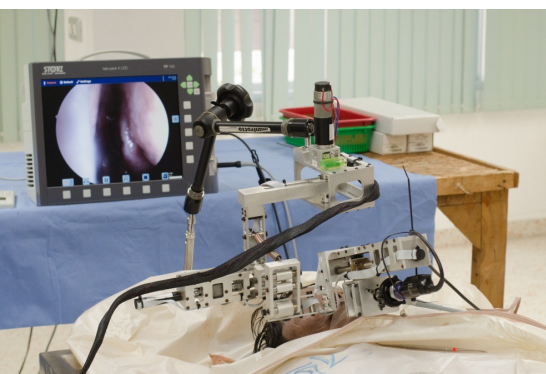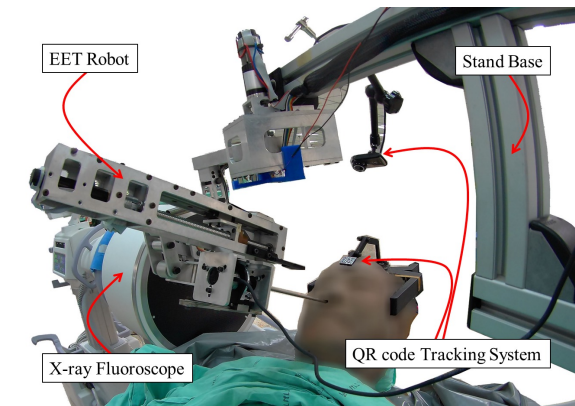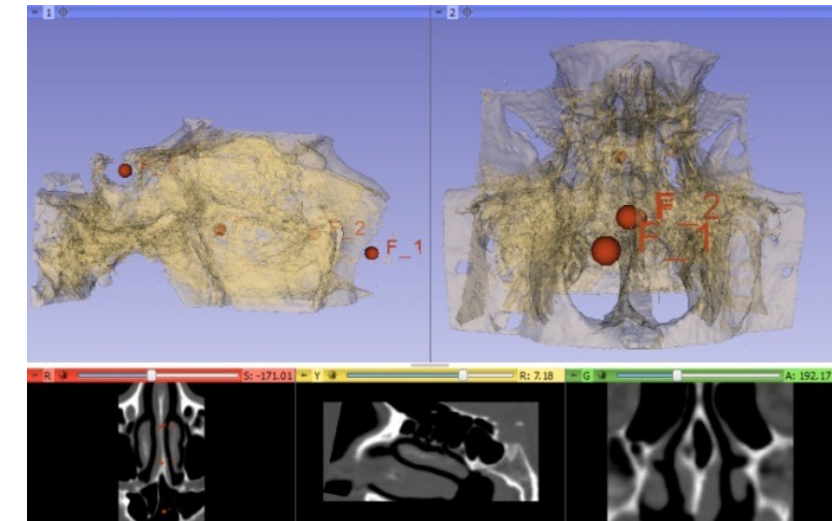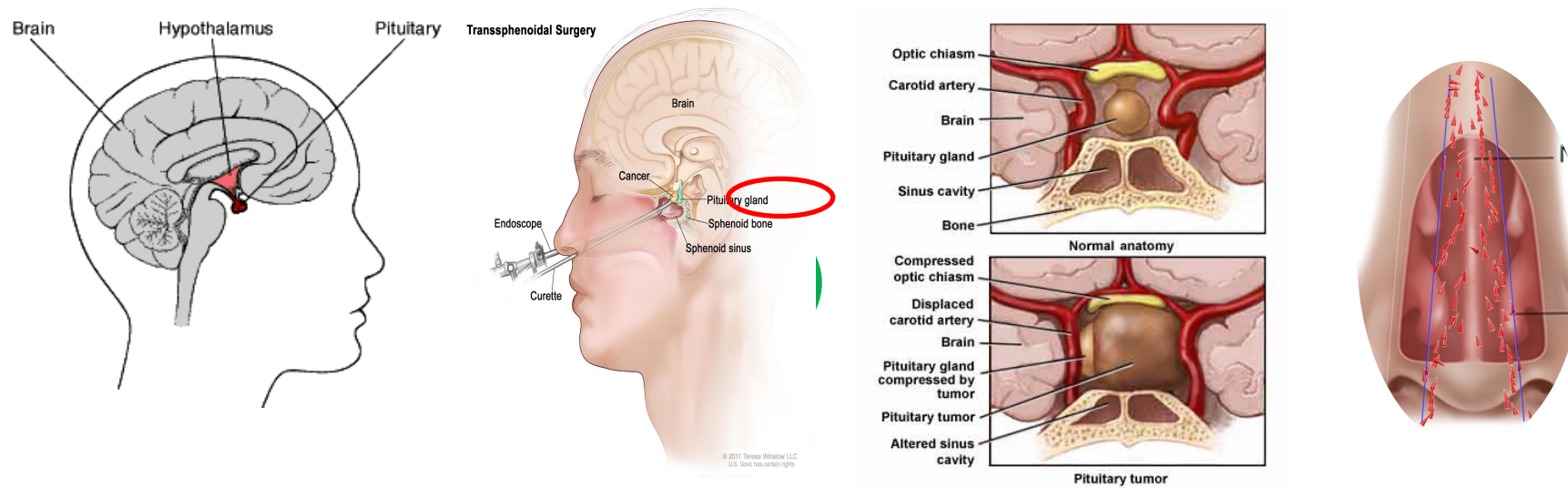
- Chamnanvej, S., Chalongwongse, S., Pillai, B., and Suthakorn, J., "Endonasal endoscopic transsphenoidal approach robot prototype: A cadaveric trial," *Asian Journal of Surgery, 2021, Vol. 44(1), pp. 345-351.*
- Chalongwongse, S., Chumnanvej, S., and Suthakorn, J., "Analysis of Endonasal Endoscopic Transsphenoidal (EET) surgery pathway and workspace for path guiding robot design," *Asian Journal of Surgery, Vol. 42(8), 2019, pp. 814-822.*
- Chumnanvej, S., Pillai, B., M., and Suthakorn, J., "Surgical Robotic Technology for Developing an Endonasal Endoscopic Transsphenoidal Surgery (EETS) Robotic System," *Open Neurology Journal, Vol. 13(1), 2019, pp. 96-106.*
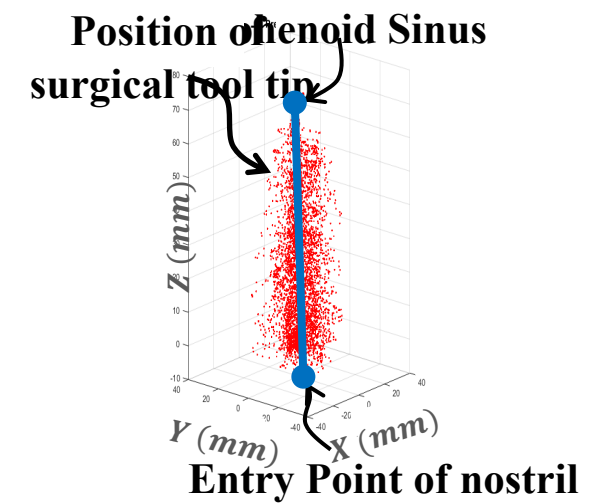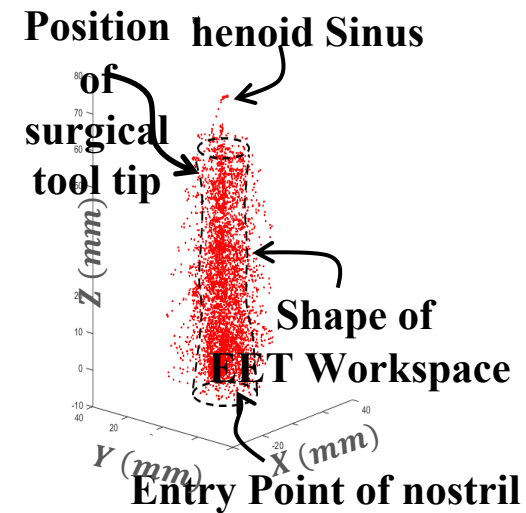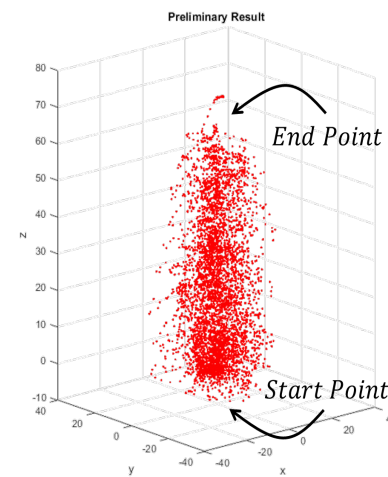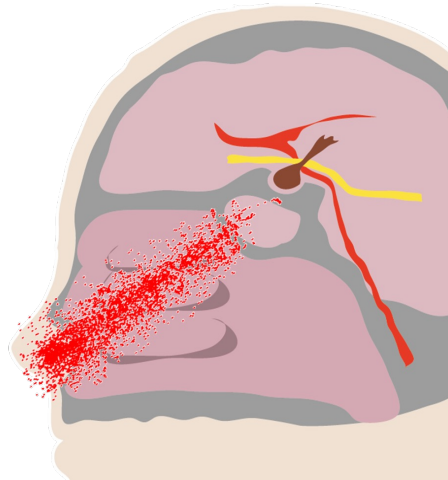
Medical Robotics
Surgical Robotics

EETS Simulator: A Virtual Reality Haptic EETS Surgical Training System

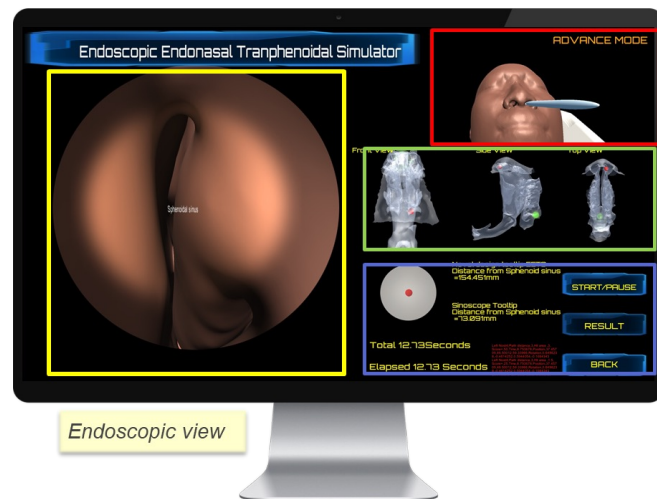Jackrit Suthakorn[1], Sorayouth Chamnanvej, MD[2], Nantida Nillahoot[1], Branesh Pillai[1]
[1]BART LAB, Faculty of Engineering, Mahidol University,
[2]Department of Surgery, Faculty of Medicine Ramathibodi Hospital, Mahidol University

Preliminary Result

End Point

Start Point

Position of surgical tool tip

henoid Sinus

Shape of EET Workspace

Entry Point of nostril

Position of henoid Sinus surgical tool tip

Entry Point of nostril

Methodology : GUI

Endoscopic Endonasal Tranphenoidal Simulator

ADVANCE MODE

Distance from Sphenoid sinus
=154.45mm

Sinoscope Tooltip
Distance from Sphenoid sinus
=19.89mm

START/PAUSE

RESULT

BACK

Total 12.73Seconds
Elapsed 12.73 Seconds

Endoscopic view

Software features

Outside view of patient

Yellow marker show position of tooltip in Coronal ,Sagittal and Axial view

Information of tooltip position and time elapsed

• Nillahoot, N., Pillai, B., Chamnanvej, S., and Suthakorn, J., "The Development of A Virtual Simulator for A Novel Design Surgical Tool in Endoscopic," *Bulletin of Electrical Engineering and Informatics, 2021, Vol. 10 (3), pp. 1368-1379.*
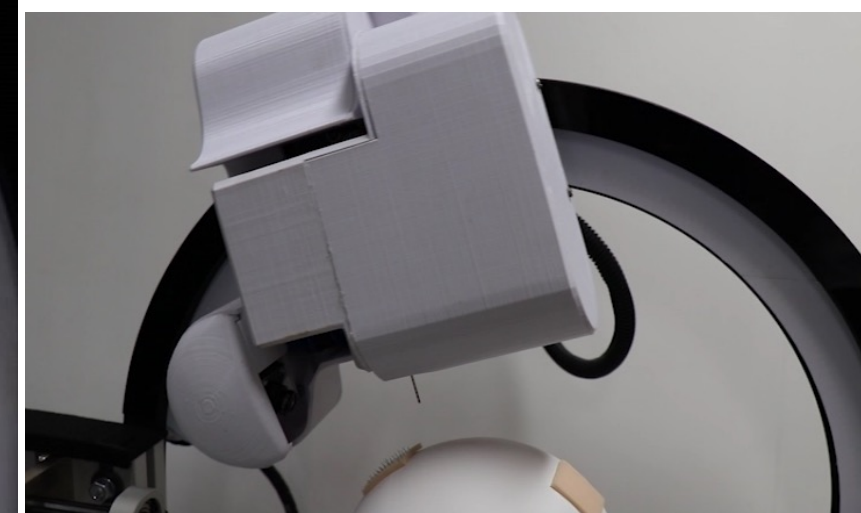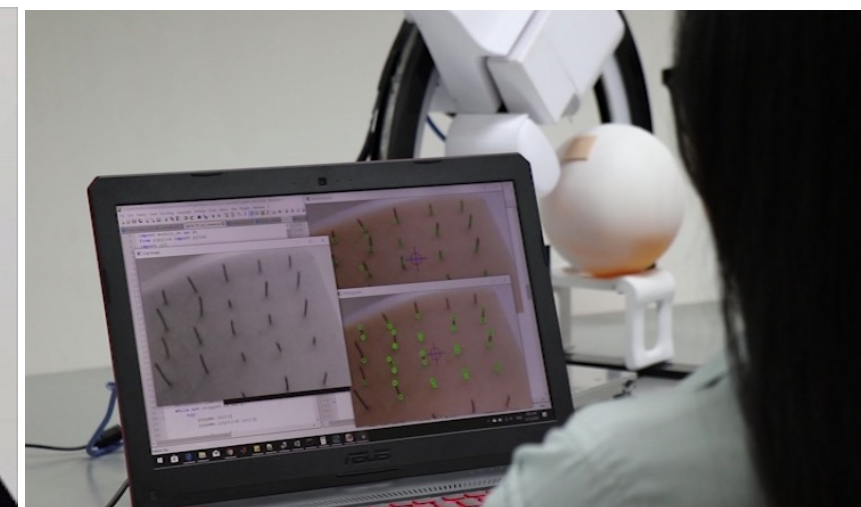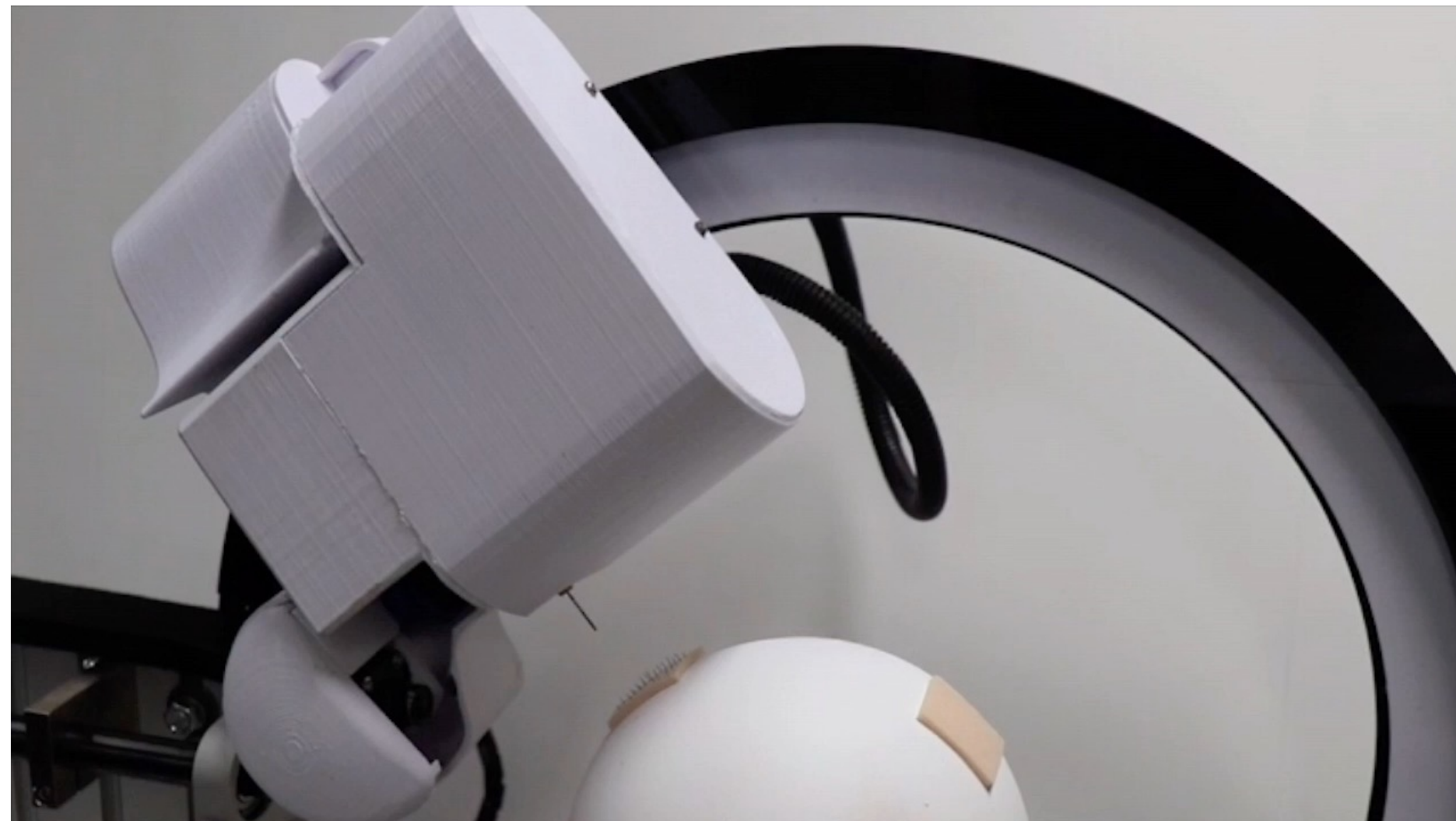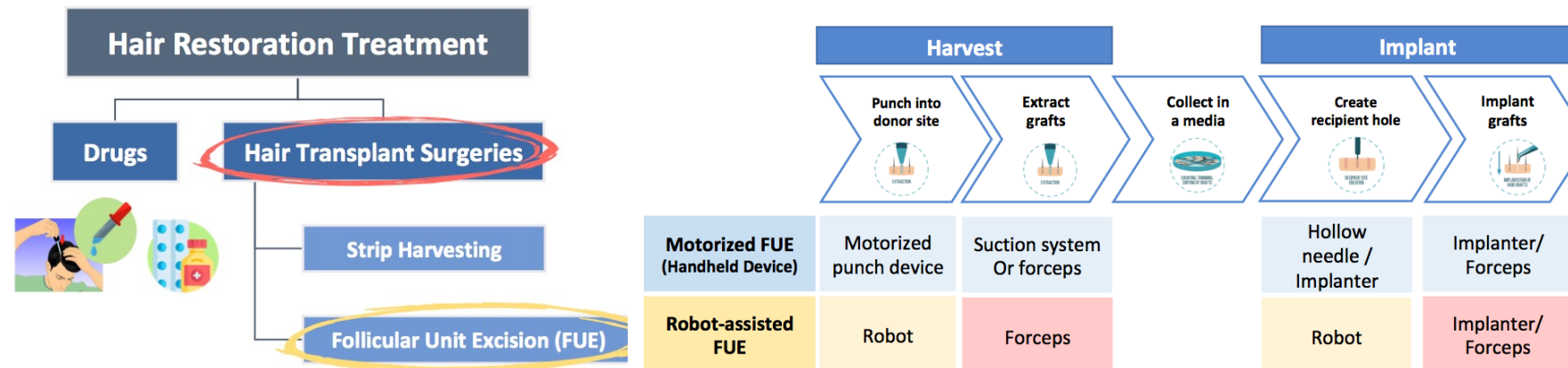
Hair-Trans Robot: Harvest and Implant Mechanism

Jackrit Suthakorn[1], Rattapon Tuangtong, MD[2], Ardra Asok[1], Mohammad Sanaeenamaghi[1]
[1]BART LAB, Faculty of Engineering, Mahidol University,
[2]Department of Dermatology, Faculty of Medicine Siriraj Hospital, Mahidol University

Medical Robotics
Rehabilitation Robotics

BART LAB LL-EXO 1: Design and Motion Analysis

Jackrit Suthakorn[1], Pitchaya Rayothee[2], Wanchan Banchadit[1], Acharaporn Temram[1], Tassanai Sukwan[1], Peeraapat Owatchaiyapong[1]
[1]BART LAB, Faculty of Engineering, Mahidol University,
[2] Sirindhorn School of Prosthetics and Orthotics, Faculty of Medicine Siriraj Hospital, Mahidol University
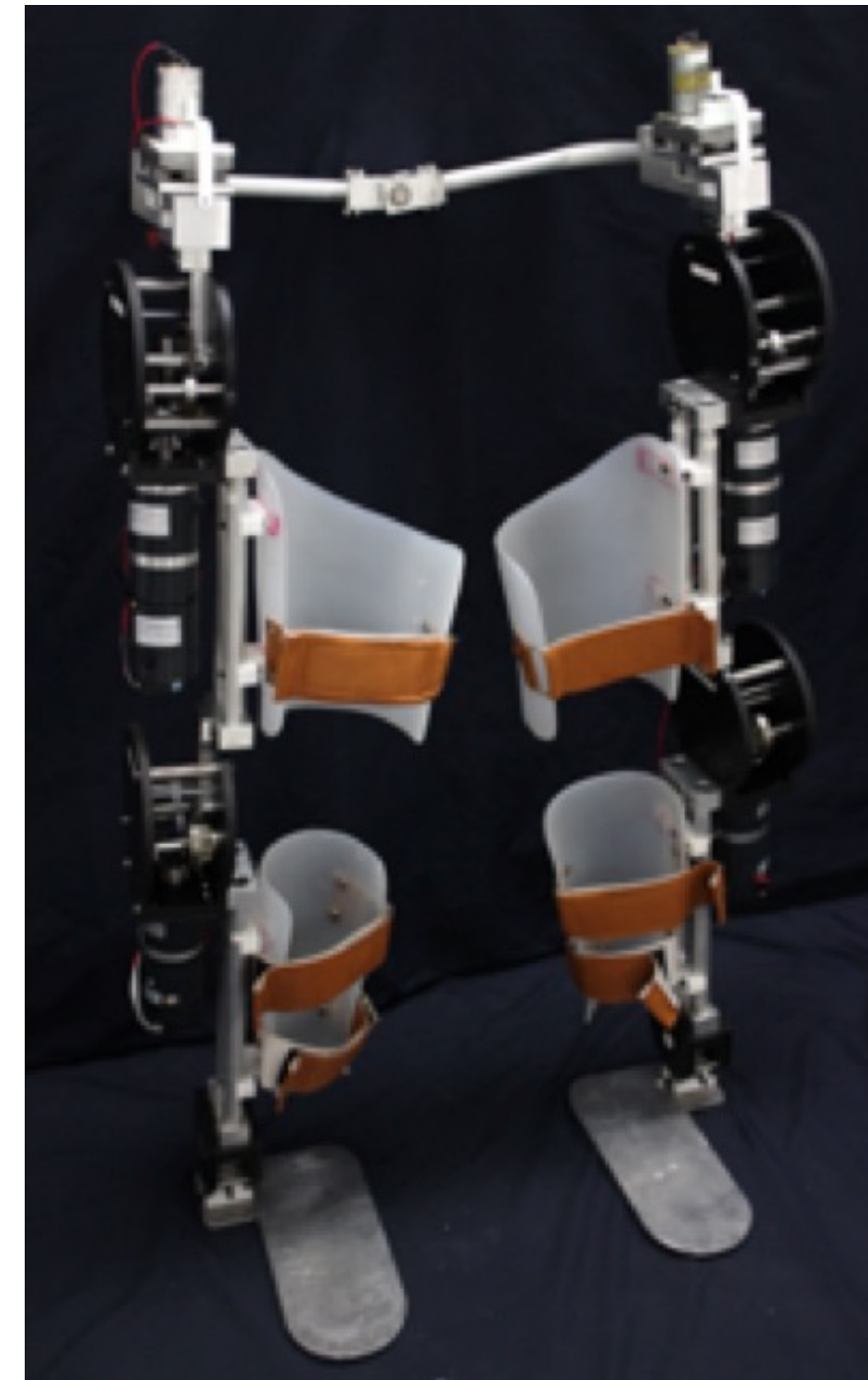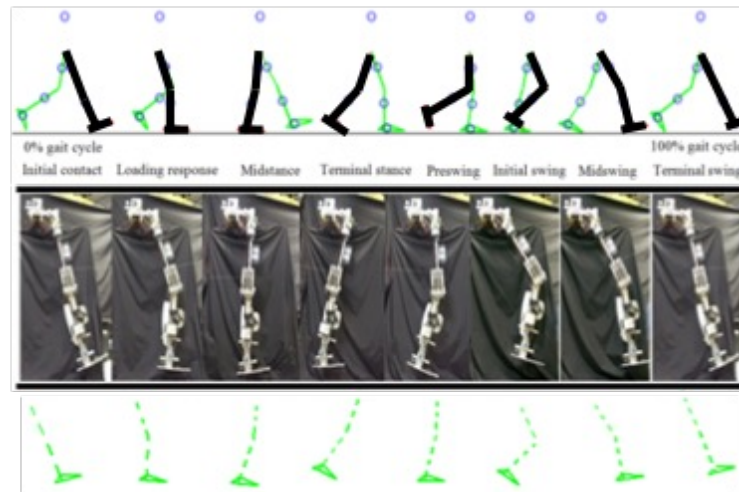
• Banchadit, W., Temram, A., Sukwan, T., Owatchaiyapong, P., and Suthakorn, J., "Design and Implementation of a New Motorized-Mechanical Exoskeleton Based on CGA Patternized Control," *Proc. 2012 IEEE Int'l Conf. on Robotics and Biomimetics (ROBIO 2012), 2012, Guangzhou, China, pp. 1668-1673.*
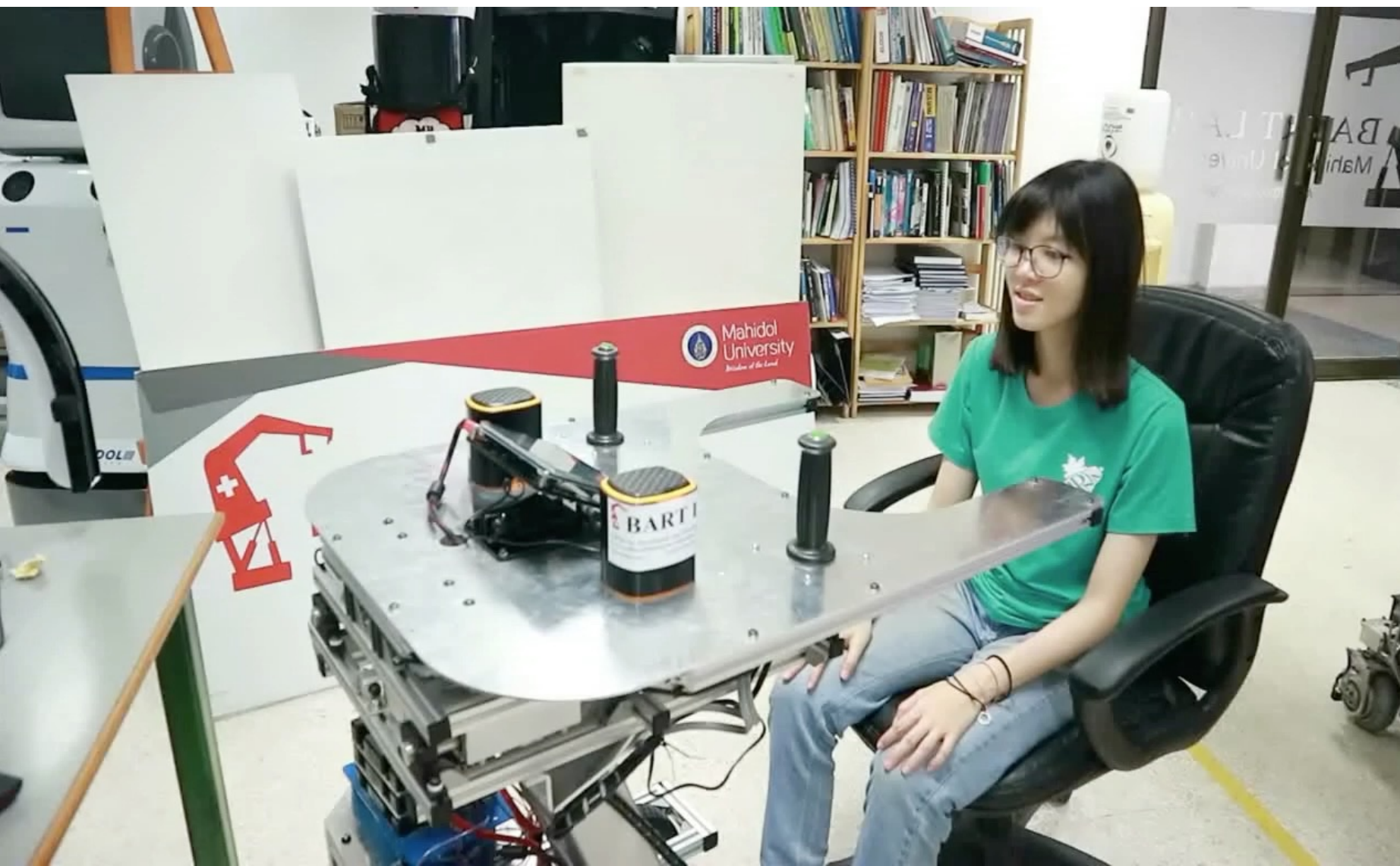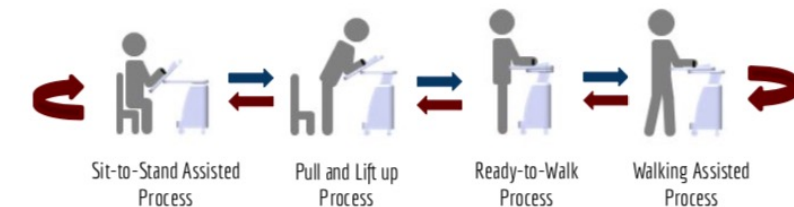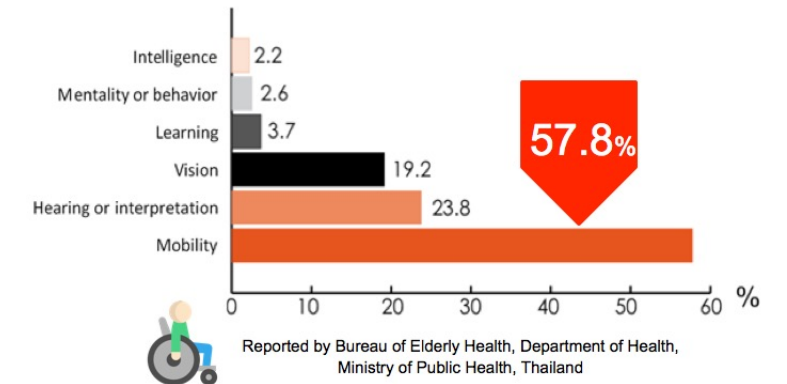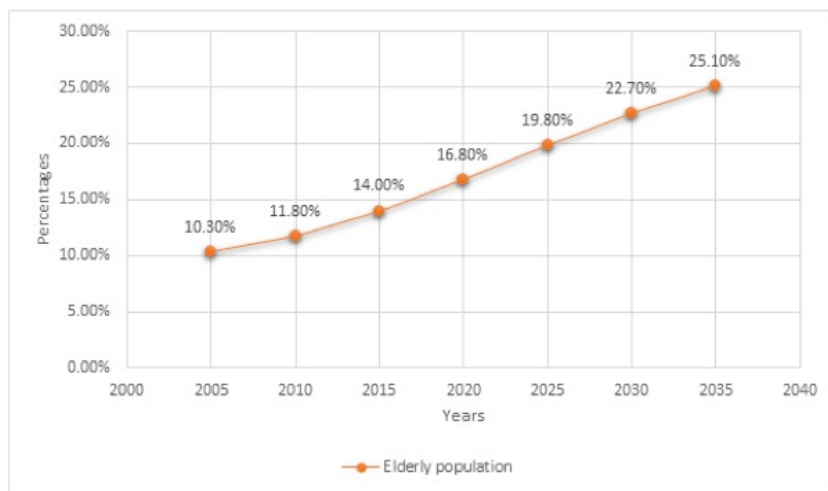
Medical Robotics
Rehabilitation Robotics

Robot Assisted Elderly Carrying System

Jackrit Suthakorn[1], Bibhu Sharma[1], Weerasak Muangpaisan, MD[1]
[1]BART LAB, Faculty of Engineering, Mahidol University,
[2]Department of Preventive and Social Medicine, Faculty of Medicine Siriraj Hospital, Mahidol University

Percentages of elderly population compared to overall population from 2005 to 2035, reported by Institute for Population and Social Research, Mahidol University

Reported by Bureau of Elderly Health, Department of Health, Ministry of Public Health, Thailand

Sit-to-Stand Assisted Process — Pull and Lift up Process — Ready-to-Walk Process — Walking Assisted Process

Medical Robotics
Hospital Service and Logistics

BART LAB AGV: Drug Logistic Mobile Robot
Jackrit Suthakorn[1], Karat Thanaboonkong[1], Rachot Puengsuk[1], Pittawat Thiuthipsakul[1], GJMC Staffs[2], Panasonic Engineers[3]
[1]BART LAB, Faculty of Engineering, Mahidol University,
[2]Golden Jubilee Medical Center, Faculty of Medicine Siriraj Hospital, Mahidol University
[3]Panasonic Corporation, Osaka, JAPAN

• Thanaboonkong, K., and Suthakorn, J., "A Study and Development on Robotic Drug Storaging and Dispensing System in Drug Logistics for A Mid-Sized Hospital," *Proceedings of the 2014 IEEE International Conference on Robotics and Biomimetics (ROBIO 2014), Bali, Indonesia, December 5-10, 2014, 2014, pp. 2116-2120.*

Medical Robotics
Hospital Service and Logistics

DoctoSight: A Tele-Diagnosis Robot

Jackrit Suthakorn, Korn Borvorntanalanya, Pittawat Thiuthipsakul, Suvipat Chalongwongse, Choladawan Moonjaita, and Slipakorn's Faculty Staffs
BART LAB, Faculty of Engineering, Mahidol University, Under Collaboration with Silpakorn University

Docto-Sight
Tele-Diagnosis Robot

Under Collaboration with Silpakorn University

• Borvorntanajanya, K., Thiuthipsakul, P., Chalongwongse S., Moonjaita, C., and Suthakorn, J., "Development of Differential Suspension Wheeled System for Telepresence System in Rural Hospital Area," *Proceedings of the 2016 IEEE International Conference on Robotics and Biomimetics (ROBIO 2016), Qingdao, China, December 3-7, 2016, pp. 1046-1051.*
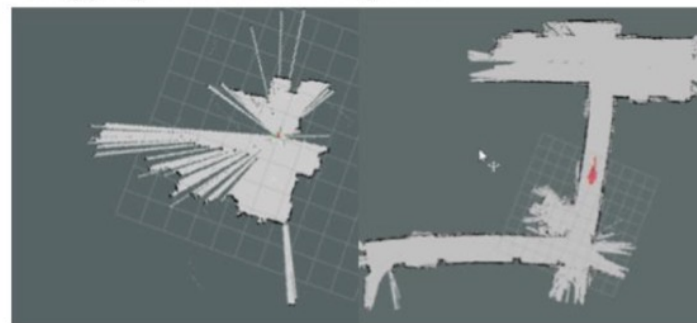
DoctoSight II: A Intelligent Mobile Tele-Medicine Robot

Jackrit Suthakorn, Korn Borvorntanalanya, Pittawat Thiuthipsakul, Choladawan Moonjaita,
BART LAB, Faculty of Engineering, Mahidol University,
Under Collaboration with Faculty of Medicine Siriraj Hospital and Faculty of Medicine Ramathibodi Hospital`

- Vital Signs Transferring System
- Integrated IOT System
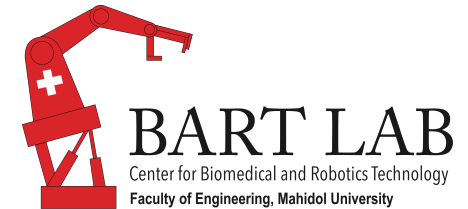- Mapping & Navigation System
- Telepresence System

Acknowledgement

www.BARTLAB.org