

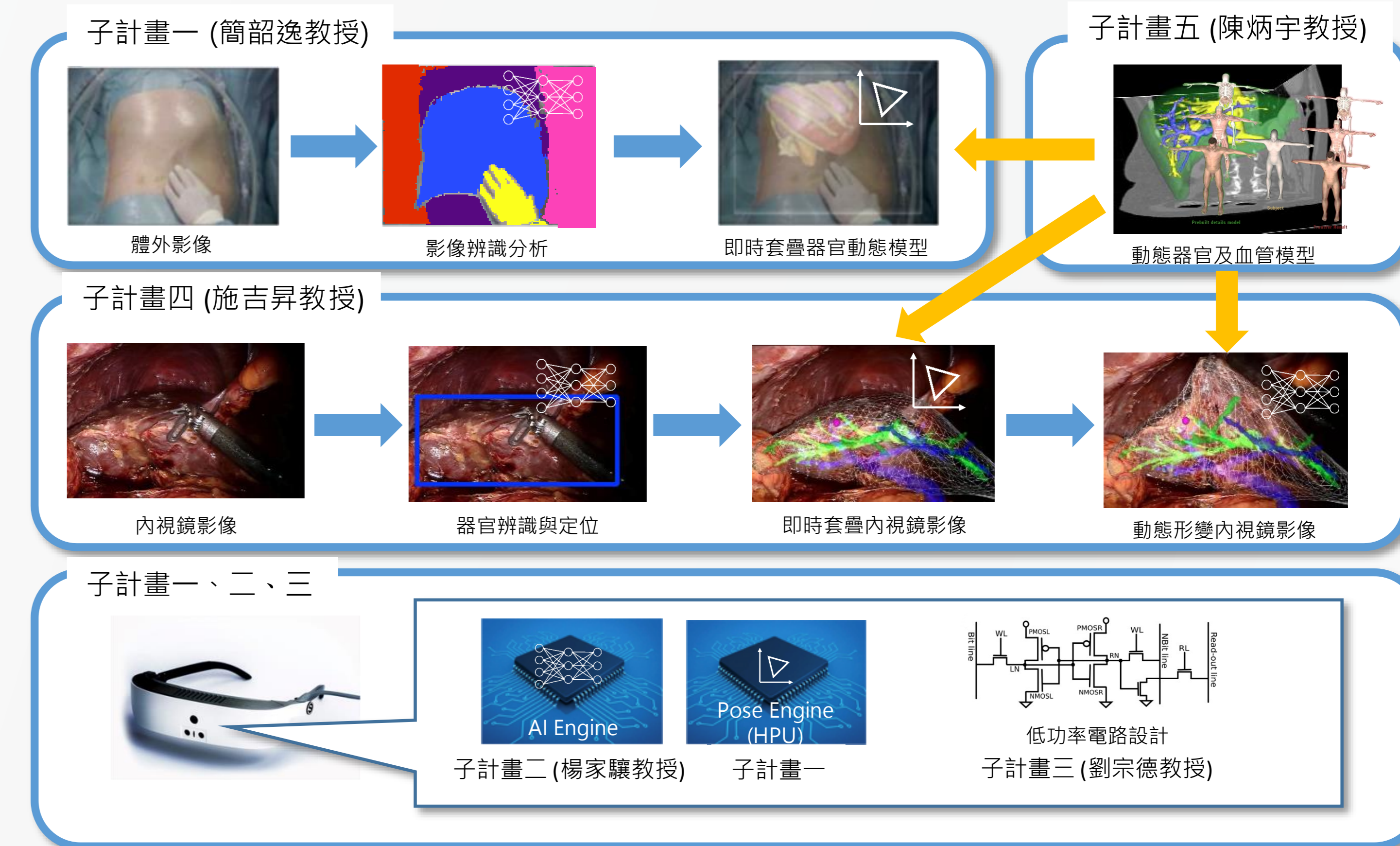
計畫主持人：國立臺灣大學 簡韶逸、楊家驥、劉宗德、施吉昇、陳炳宇
 計畫共同主持人：臺大生醫電資所 郭柏齡、臺大醫院新竹分院 黃俊雄、亞東醫院 李建勳、奇美醫院柳營分院 王嘉聲
 執行單位：國立臺灣大學電子所

計畫介紹

- AI Aug Surgery: Surgery Assistance System with AI + AR
- 手術即時資訊顯示：病灶、器官、血管
- 輔助外科醫生以及協助外科醫師之訓練

總體目標

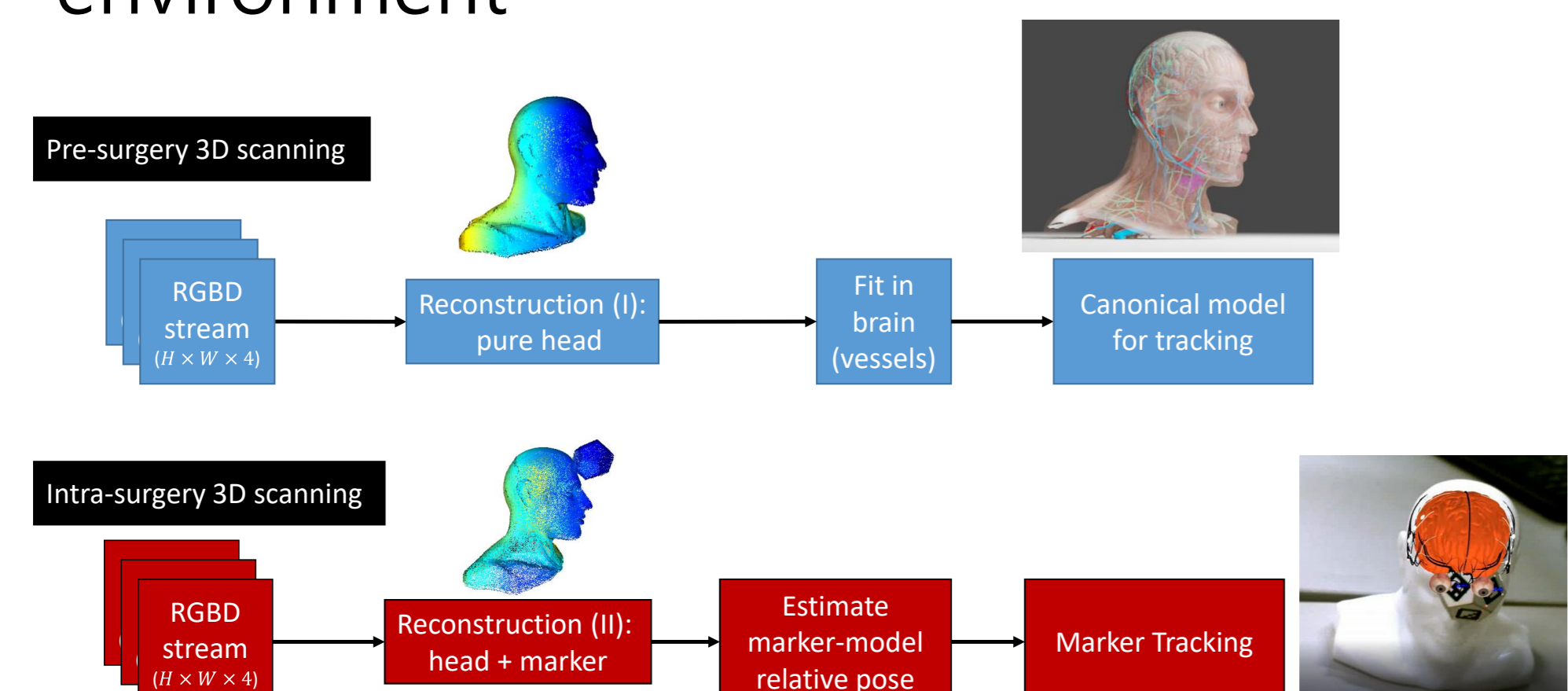
- 目標手術為腹腔外科之肝臟手術，耳鼻喉外科之頸部淋巴癌手術、腹腔外科之腸沾黏分離手術、腦神經外科之顱底手術，精確度達1cm(腹腔外科)—3mm(腦神經外科)
- 產出高階AR應用系統的關鍵技術



成果亮點

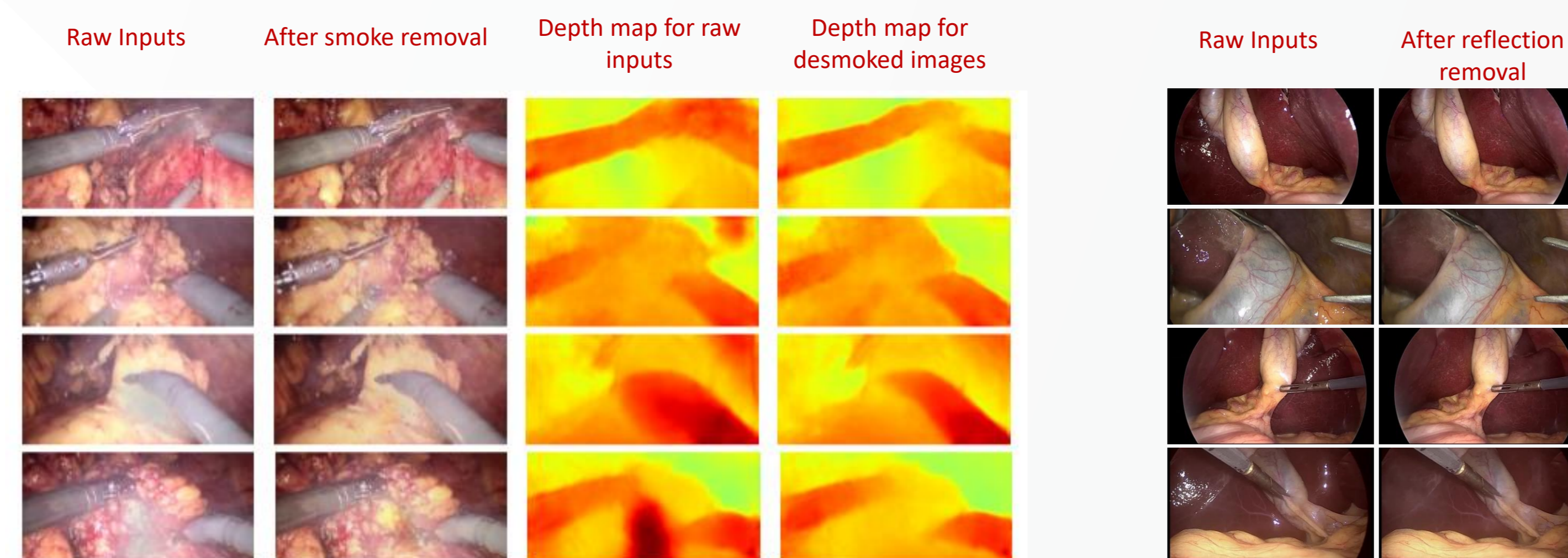
AI Aug Surgery System: 6-DoF Pose Calibration and Marker Tracking System for Rigid Organs

- Accuracy: 0.5mm in dataset, 1mm in real systems
- Hardware accelerator IP: achieve 100fps in FPGA verification environment



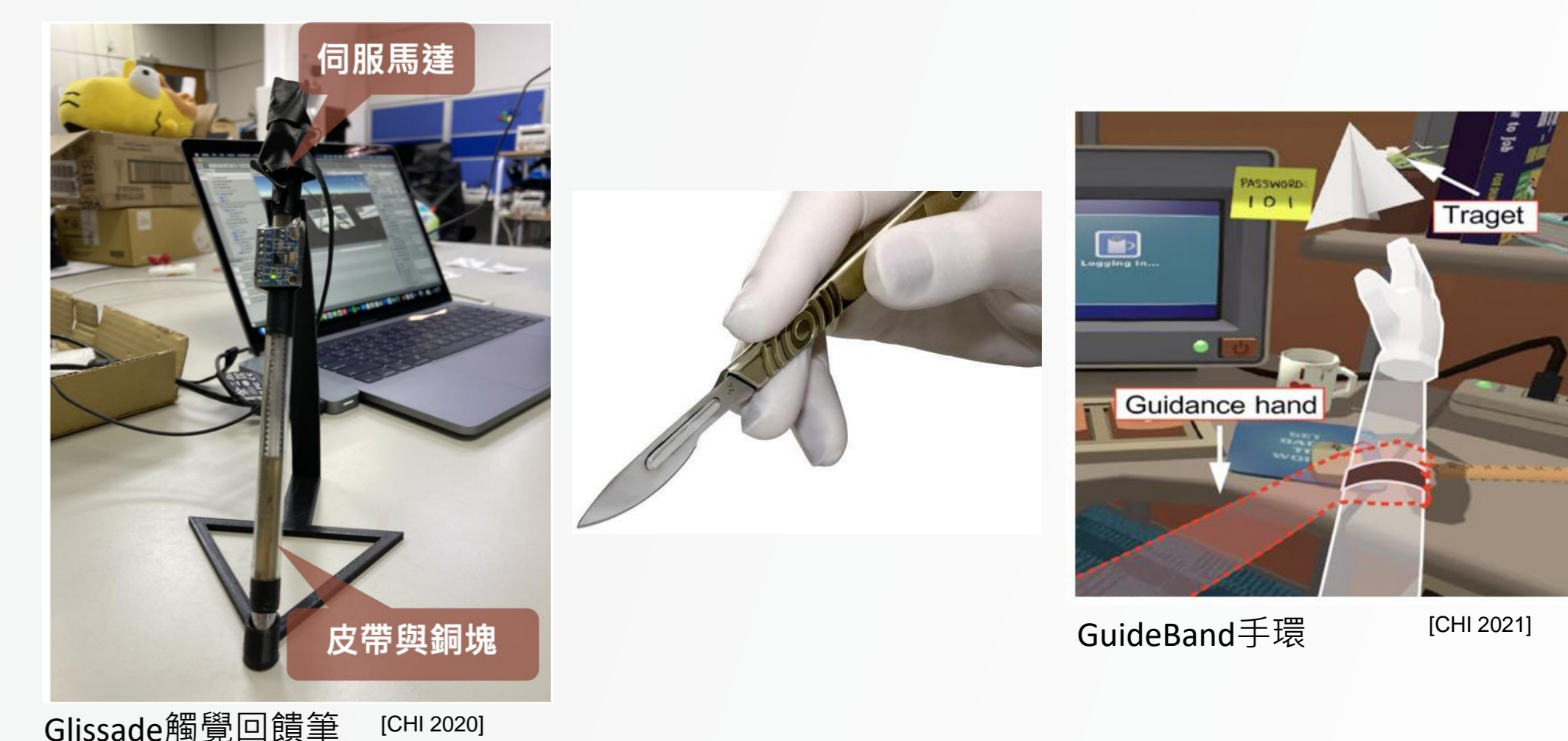
AI Aug Surgery System: 3D Reconstruction and Image Processing for Endoscopes

- Depth estimation
- Deblur and reflection removal



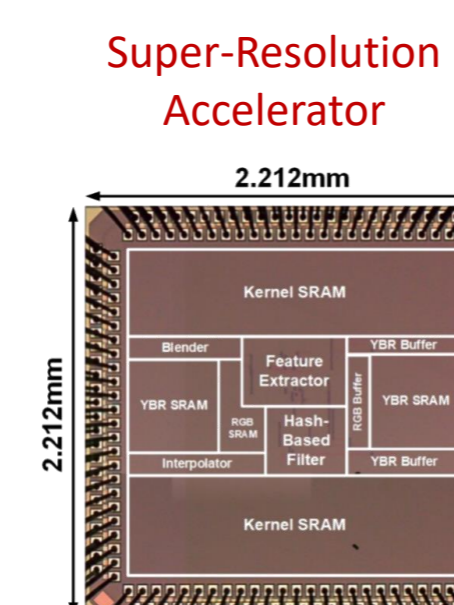
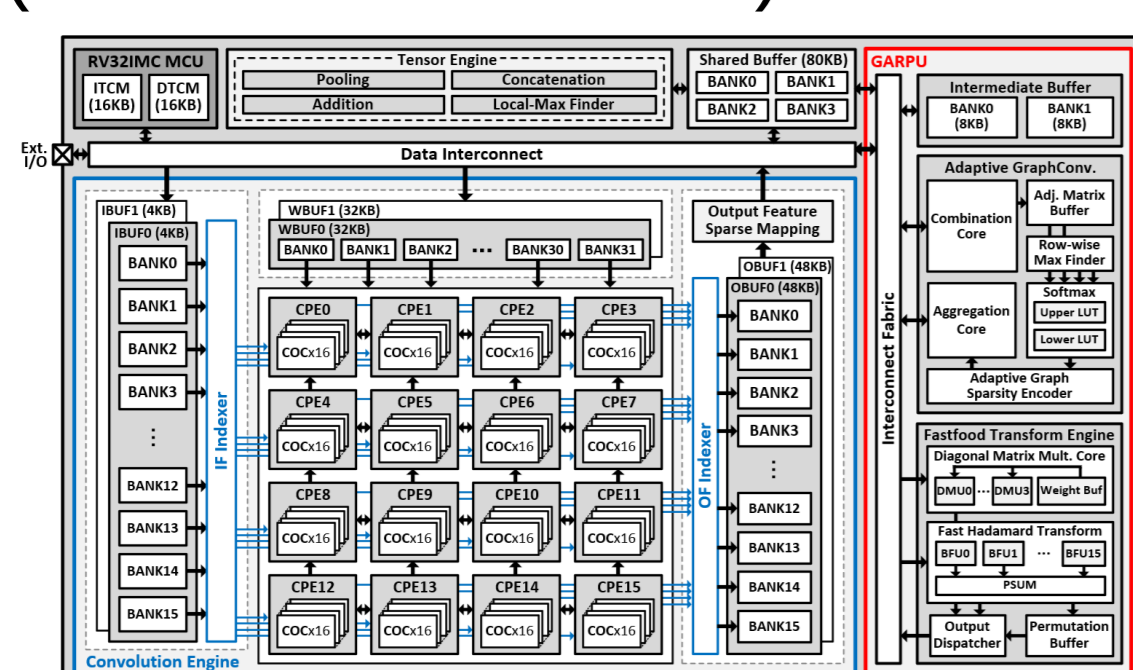
AI Aug Surgery System: Improved Haptics Experience for AR

- Glissade(觸覺回饋筆): 可用於模擬實際外科手術執刀的感覺，優點為成本低、體積小並可提供多種類型的觸覺回饋
- GuideBand手環提供多種力回饋程度：例如移動速度或距離等等，給以更多導引資訊。

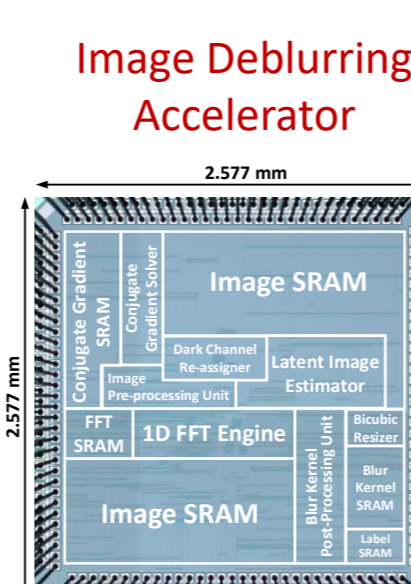


SoC Neural Network Computing Platform: Advanced Image Signal Processor

- Super resolution accelerator [ISSCC 2021]
- Image deblurring accelerator [A-SSCC 2021]
- AI SoC (RISC-V and DLA)



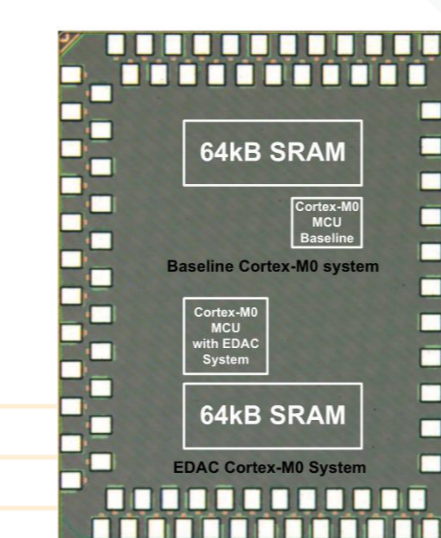
	VLSI'19	This work
Technology	65nm	40nm
Supply voltage [V]	1.1	0.93
Core area (mm ²)	13 (est.)	3.33
SRAM (kB)	572	371
Max freq. (MHz)	200.0	200.0
Throughput (fps)	25-60	90
Power(mW)	211	91
Normal Energy (mj/frame)	2.16-5.19'	1.01
TAR'' (fps/mm ²)	5.08-12.19'	27.27



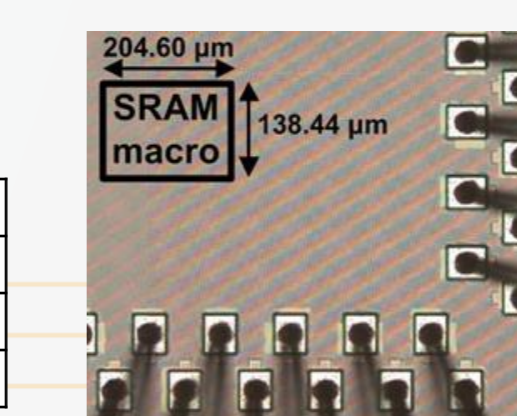
	P. Raina (JSSC'17)	This work
Technology	40nm	40nm
Blur kernel size	Up to 21*21	Up to 49*49
Core area (mm ²)	4.41	3.98
Max. Freq. (MHz)	25-83	137
Power (mW)	59.5 (0.9 V, 83 MHz)	28.8 (0.65V, 65 MHz)
Norm. Area Efficiency (pixel/(sec * mm ²))	23 (Kernel size: 13*13)	92 (Kernel size: 25*25)
Norm. energy efficiency (pixel / mJ)	1.7	12

SoC Neural Network Computing Platform: Low-power Circuits for AI Aug Surgery

- Low-power processor for AI Aug Surgery [JSSC]
- Low-Power Memory for AI Aug Surgery [TCAS-I]
- Low-Power CIM Accelerator for AI Aug Surgery [SSC-L]



	JSSC'18	Proposed
Technology	40 nm	28 nm
Minimum energy point (MEP)	11.12 pJ	3.99 pJ
Operating frequency @ MEP	7.5MHz	27.6MHz



	JSSC'18	ISSCC'18	Proposed
Technology	28 nm	10 nm	28 nm
Transistor count	6T	6T	6T
#bits/BL	256-bit	256-bit	256-bit
E _{op} per bit	N/A	N/A	0.041fJ
V _{DD}	580 mV	600 mV	0.27V
Area overhead	N/A	3.3%	8.3%

