TSINGHUA PBCSF
清华五道口

研究报告

TSINGHUA PBCSF
清华五道口

Research Report

September 14, 2024

Atlas of Autonomous Surgical Robot [2]

Research Center for Sci-Tech and Finance

Yashu Zhu, Bibo Liu

Abstract:

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2022　Saeidi [1] Science Robotics

Autonomous robotic laparoscopic surgery for intestinal anastomosis

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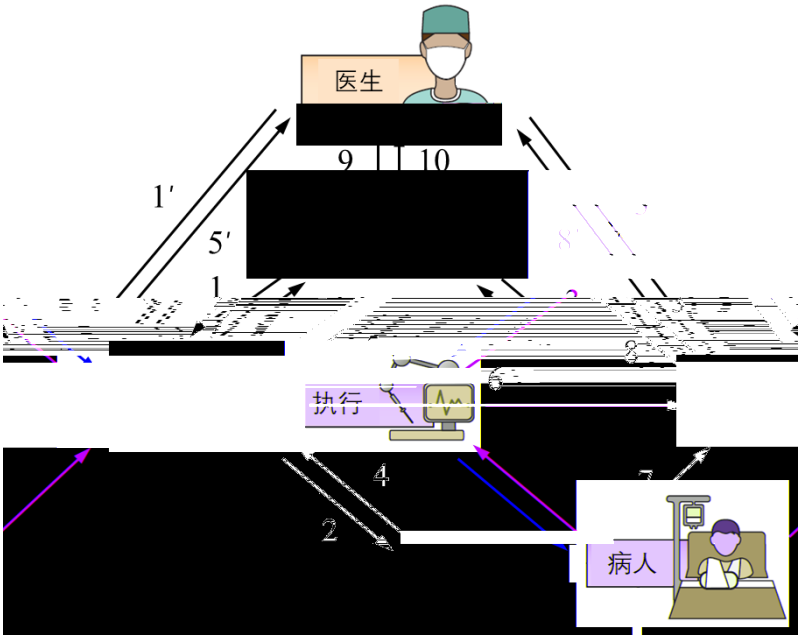

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[3-5] Óbuda Haidegger[3]

ISO/IEC[1]

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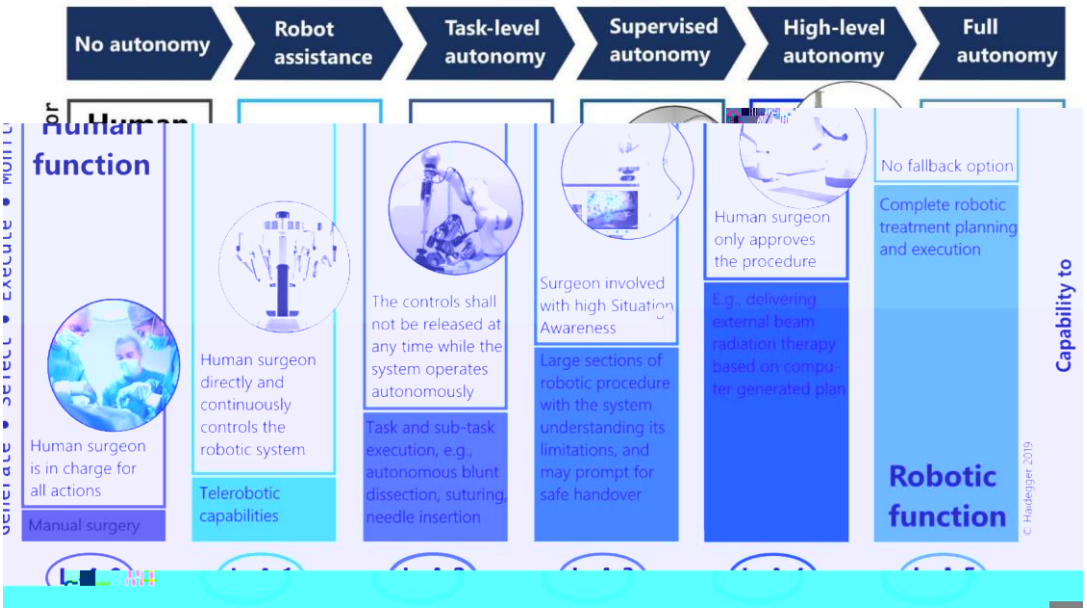

[3]

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1 STAR

STAR Smart Tissue Anastomosis Robot

- Leonard [34] 2014 STAR

STAR

2022 Saeidi [12]

Science Robotics

Autonomous robotic laparoscopic surgery for intestinal anastomosis

STAR

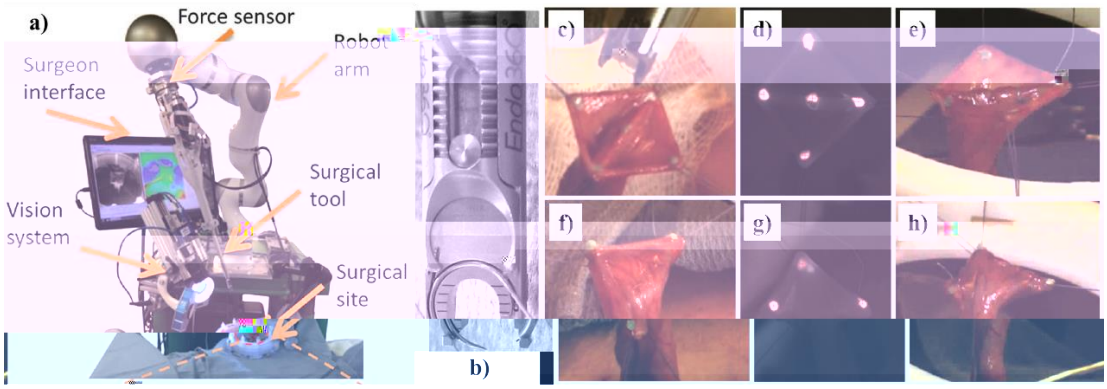
Smart Tissue Anastomosis Robot

STAR 2016 -

Shademan [9]

Science Translational Medicine

3D NIRF Near-Infrared Fluorescent Imaging



2016 Shademan [9] STAR

2-1

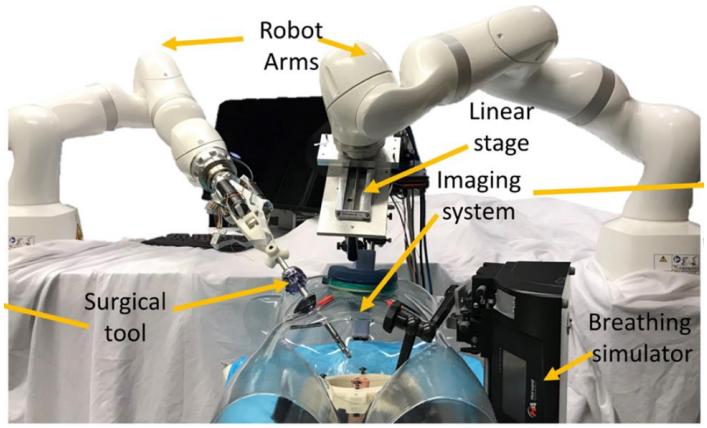
[10] [11]

2-1 b)

Endo 360◦ [8]

2-1 c)-h)

2

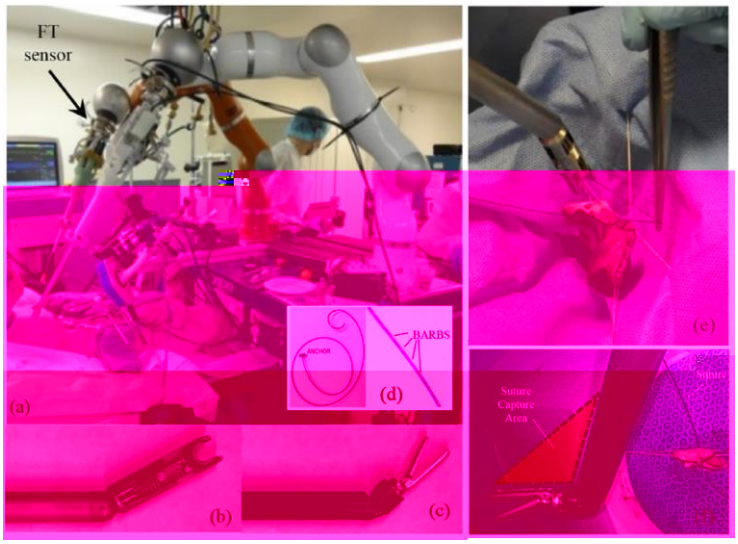


Saeidi [12] STAR

2-2

[13]

U-net



STAR 3

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Leonard [14]

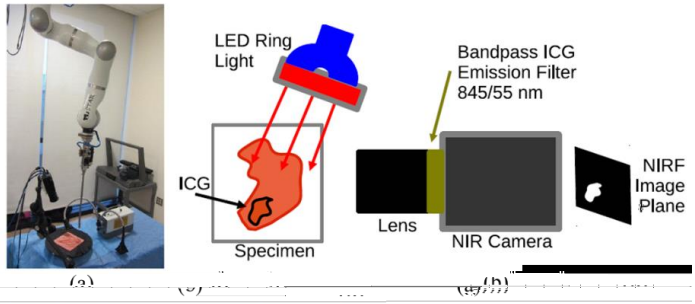
2-3

STAR 3

2-3e

Leonard [14]

2-3



(d) (c)

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Shademan [21] Near-infrared, NIR 2-4

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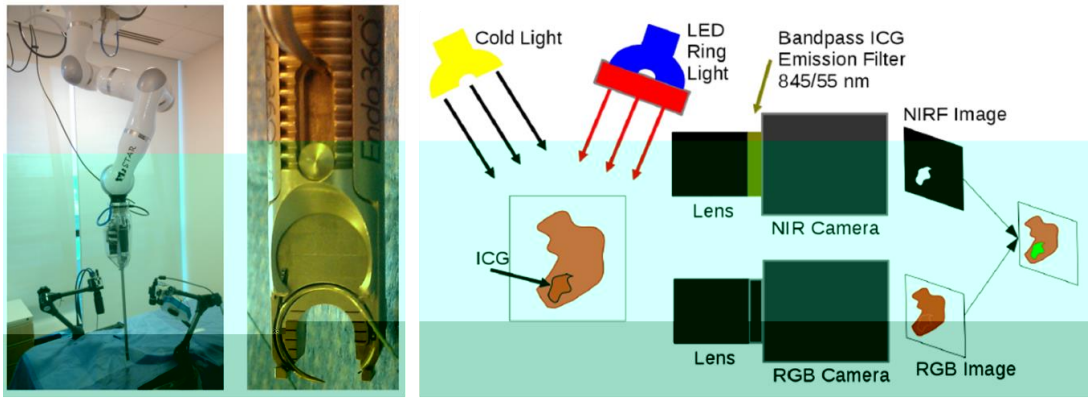

(a) (b) (c)

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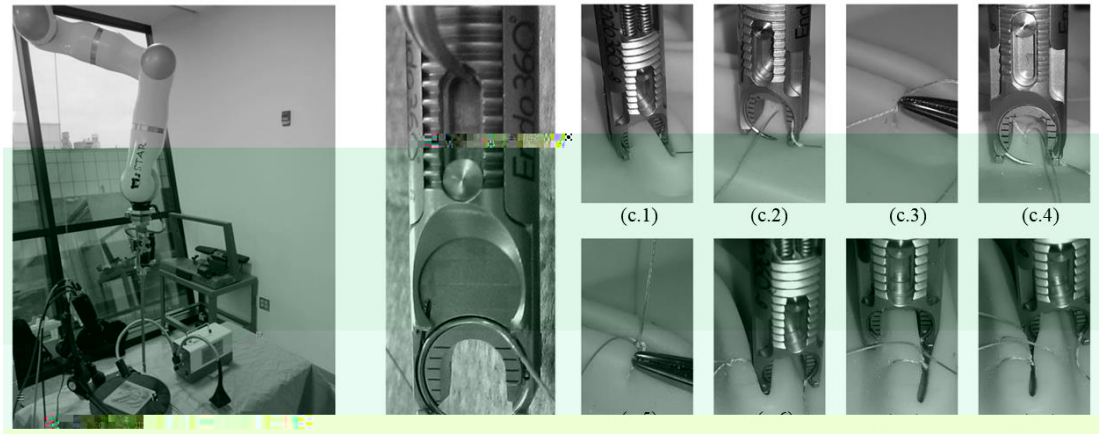
STAR

- Leonard [22]

RGB RGB

2-5 STAR

0.5 mm 0.2 mm



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Leonard [23]

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Endo360

STAR

2-6

STAR

Endo360

STAR

- Decker [24]

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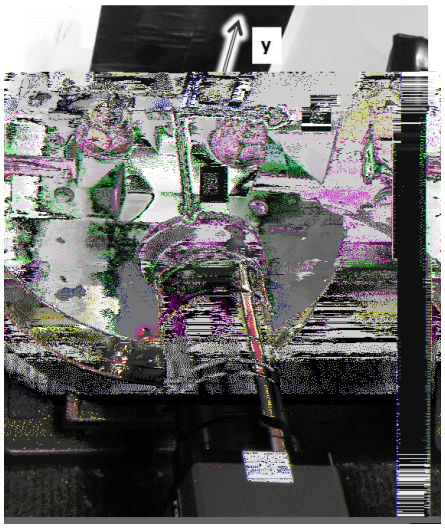
0.90 mm

STAR



2017 Decker [25]

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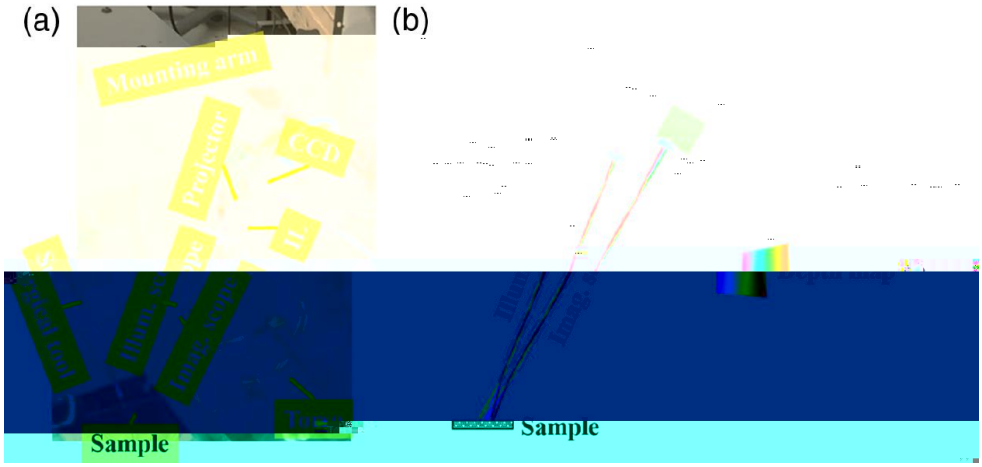
2018 Hanh [26]

2-9

20 mm 0.25 mm



2019 Saeidi [27]

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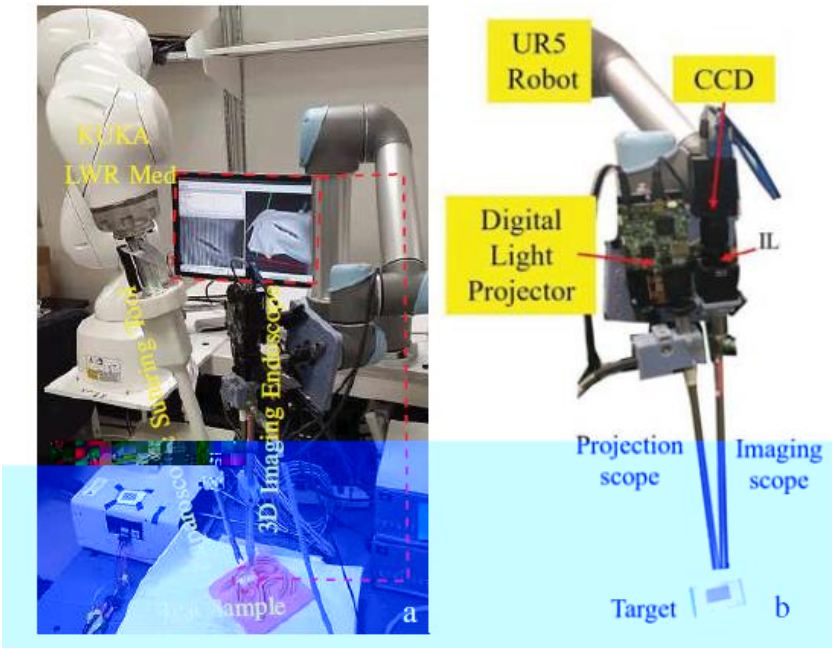
STAR

2.9



2023 Kam [28]

DeepLabCut [29]

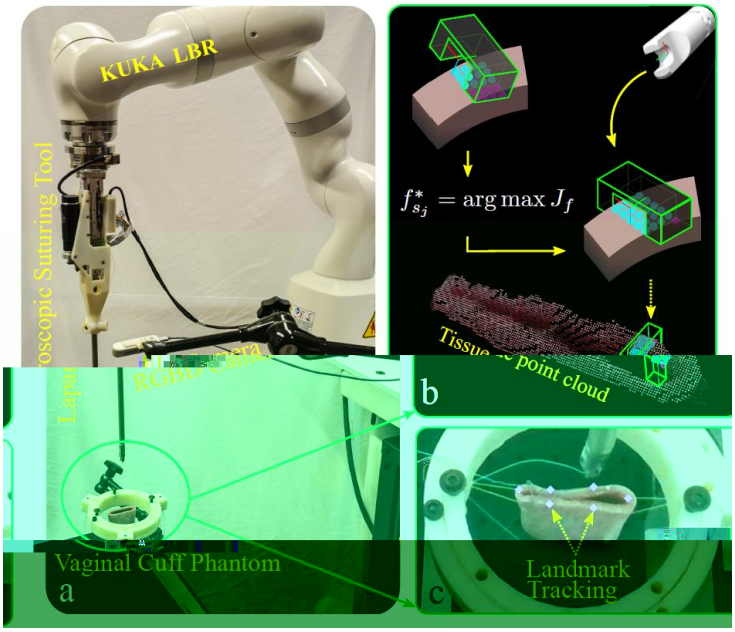
DeepLabCut

DeeperCut[30] (ResNet)[31]

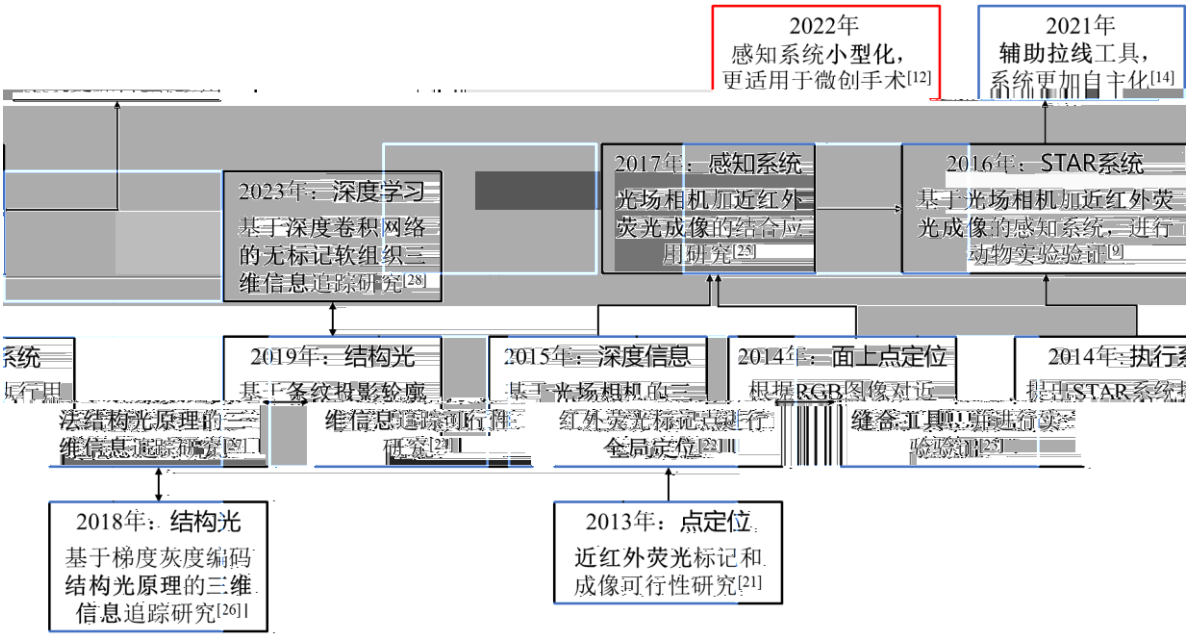
[29]

2-11 STAR

STAR


KUKA LBR
$f^*_{sj} = \arg\max J_f$
Vaginal Cuff Phantom
a
b
Landmark Tracking
c

3 STAR


2022年
感知系统小型化，
更适用于微创手术[12]
2021年
辅助拉线工具，
系统更加自主化[14]
2023年：深度学习
基于深度卷积网络
的无标记软组织三
维信息追踪研究[28]
2017年：感知系统
光场相机加近红外
荧光成像的结合应
用研究[25]
2016年：STAR系统
基于光场相机加近红外荧
光成像的感知系统，进行
动物实验验证[9]
2019年：结构光
基于条纹投影轮廓
维信息追踪可行性
研究[27]
2015年：深度信息
基于光场相机的三
红外荧光标记点进行
全局定位[22]
2014年：面上点定位
根据RGB图像对近
缝合工具进行实
2018年：结构光
基于梯度灰度编码
结构光原理的三维
信息追踪研究[26]
2013年：点定位
近红外荧光标记和
成像可行性研究[21]

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STAR STAR

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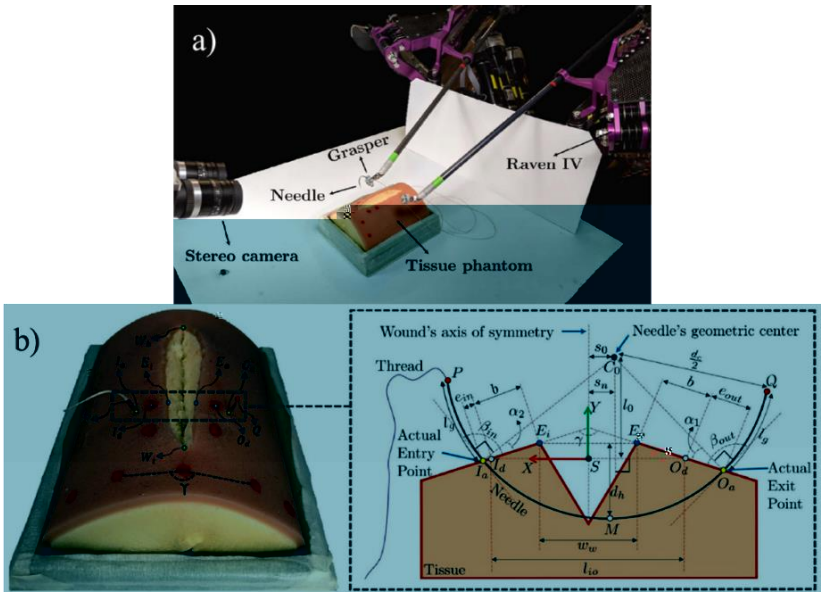

Pedram [6] Raven-IV

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[7]

2.07 mm 4.29◦

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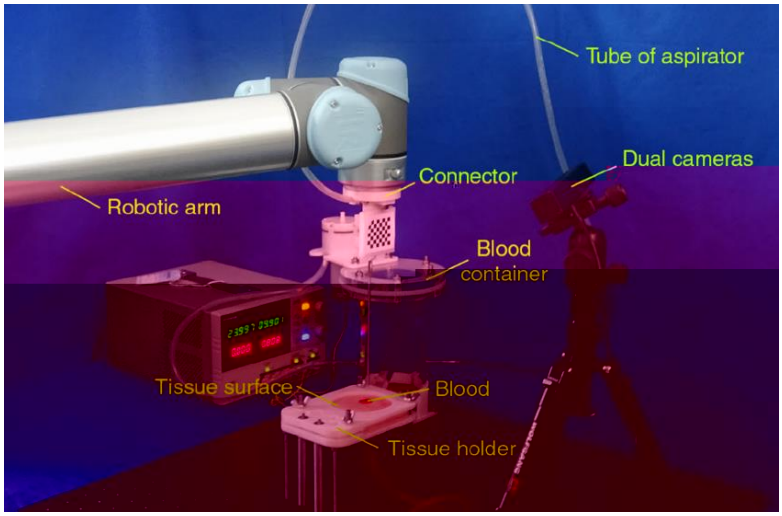

Su [18]

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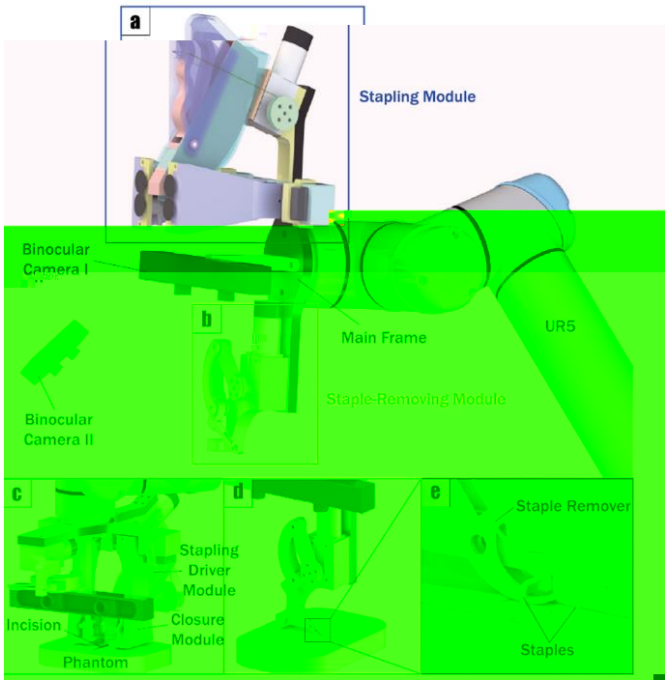
[19]

Mask R-CNN

1.37

mm [18] 4



Wang [20]

2-15

0.21 mm 0.65◦

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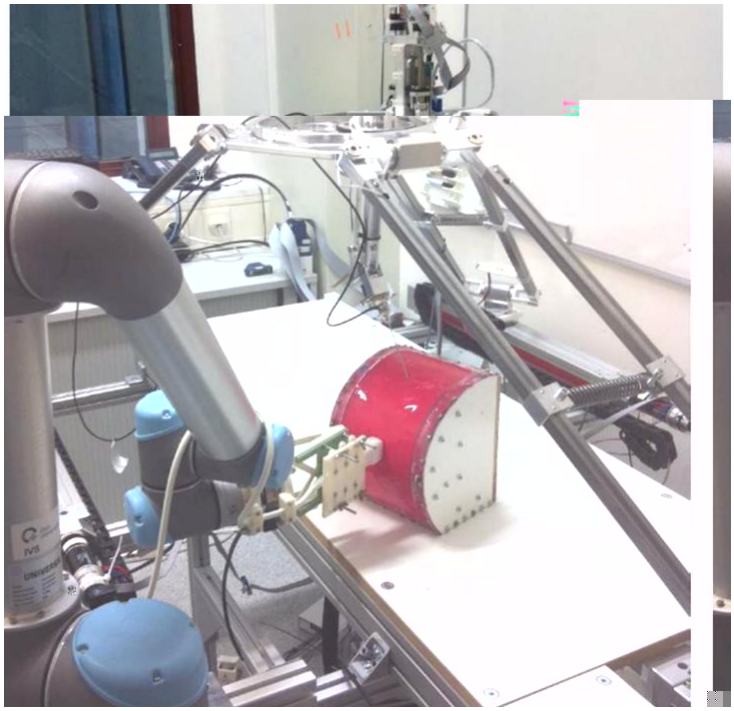
	Axel Krieger	Johns Hopkins University	Medical Devices Robotics	STAR	3
	Peter C.W. Kim Pediatric Surgeon	Brown University	Smarter Surgical Tools		
	Azad Shademan	Intuitive Surgical Inc.	Surgical Robotics; Computer Vision;		

			Visual Control; Visual Servoing		
	Simon Leonard	Johns Hopkins University	Robotics; Computer Vision		
		Beihang University	Medical Imaging Analysis; Computer Vision; Surgical Navigation; Medical Robotics		3
		Beijing University of Posts and Telecommunications	Medical Robots		4



Muradore [15] FR7

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CyberKnife

Accuray Inc. USA

KR 240 3-2 CyberKnife

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[33] CyberKnife

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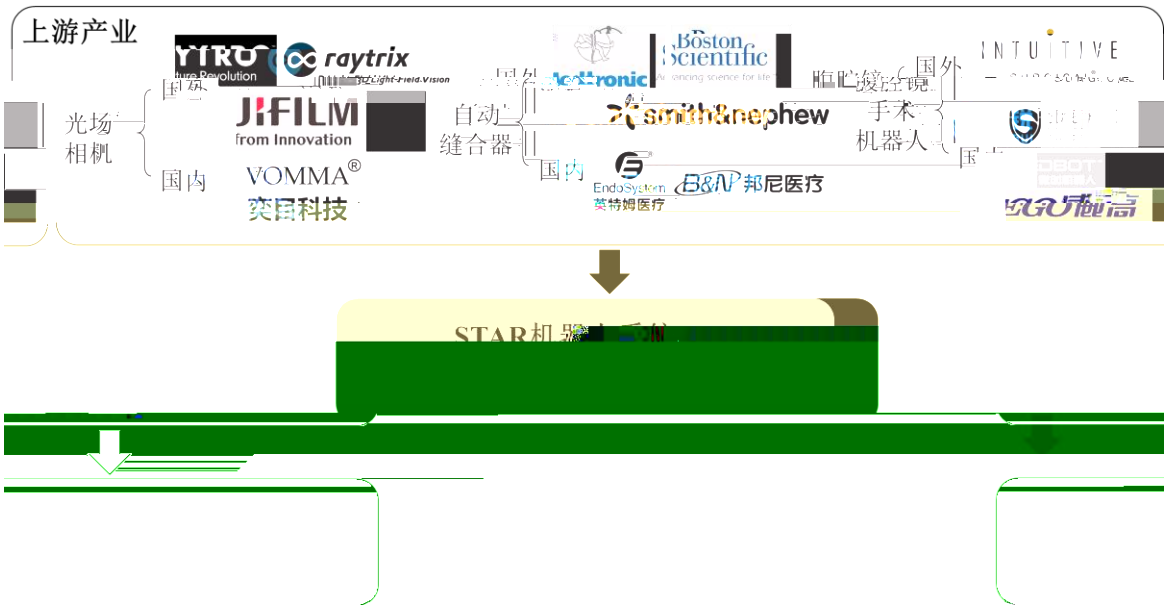
上游产业
光场相机
国内
JIFILM
from Innovation
VOMMA®
奕目科技
自动缝合器
国内
EndoSystem
英特姆医疗
B&N 邦尼医疗
手术机器人
国外
INTUITIVE

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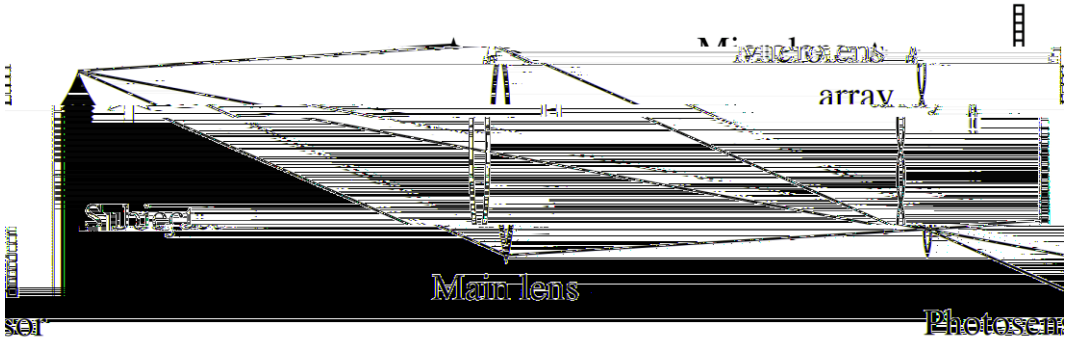
AR/VR



31.3%

2022 3.2 , 2027

12.5 , 31.3%

Lytro Raytrix Lytro

2018 Google

Lytro

Ren Ng Lytro

2D 3D Lytro 2012

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STAR Endo360

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2021 12

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Medtronic Smith Nephew, Inc. Boston Scientific Corporation Sutrue Limited B. Braun SE

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Medtronic		1949		31686	
Smith Nephew		1856		5549	
Boston Scientific Corporation		1979		14240	
Sutrue Limited		2012	-	-	
B. Braun SE		1839	-	8924	
		2017		-	

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( )		2018		-	

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		B+	----	----	----
		Pre-B+	2023	2	

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Autonomous Surgical Robot

Enteroanastomosis

Smart Tissue Anastomosis Robot STAR

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Near-Infrared Fluorescence Imaging NIRF

Autom

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reconstructive bowel anastomosis[J]. Journal of biomedical optics, 2018, 23(5): 056009-056009.

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STAR STAR

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