ARAMIS: Augmented Reality Assistance for Minimally Invasive Surgery using a Head-Mounted Display

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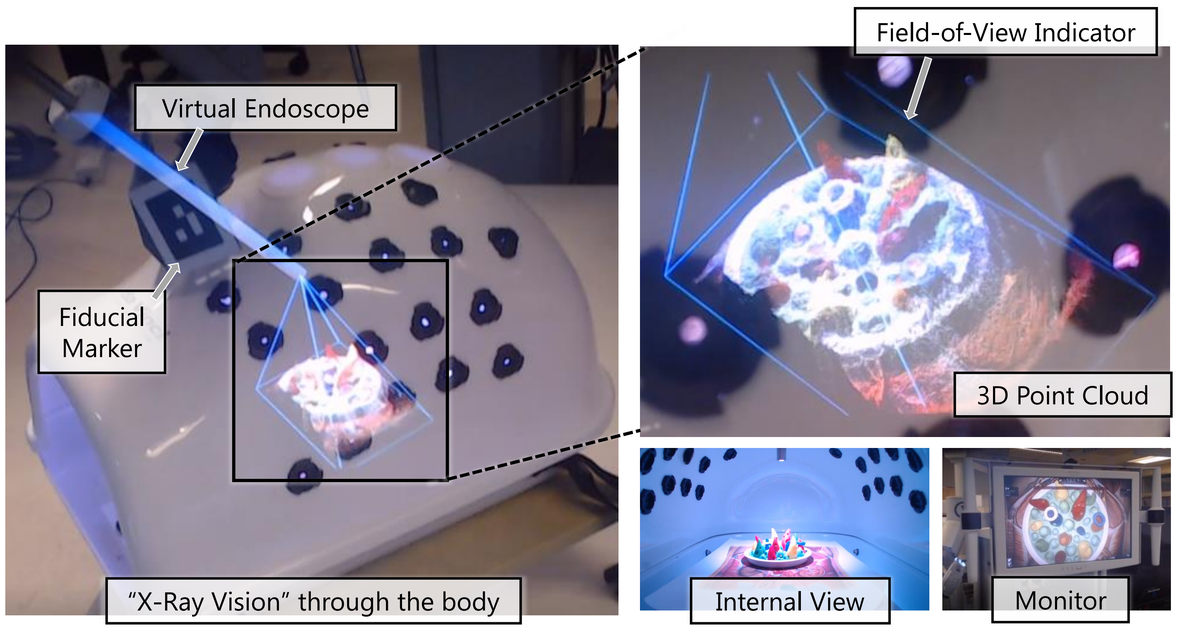
MICCAI 2019 SHENZHEN

Summary:

- ARAMIS improve the **ergonomics** of the laparoscopic surgeon and assistants, by providing "see-through **x-ray vision**" via an optical see-through head-mounted display.



Related Work:

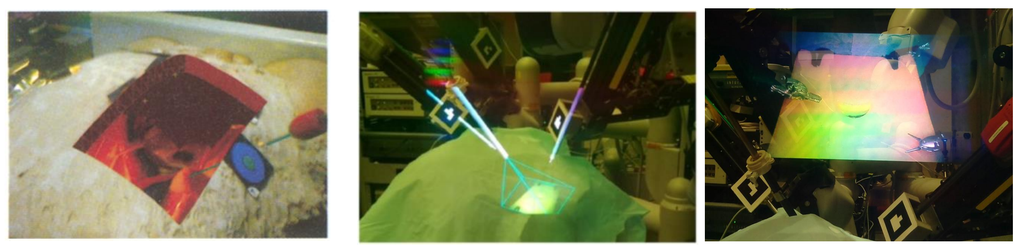
AR-Assisted Laparoscopic Surgery

1. Overlay of pre/intra operative image/models

2007 Lerotic et al. | 2007 Bichlmeier et al. | 2012 Schneider et al. | 2014 Liu et al.

2. AR visualization of laparoscopy

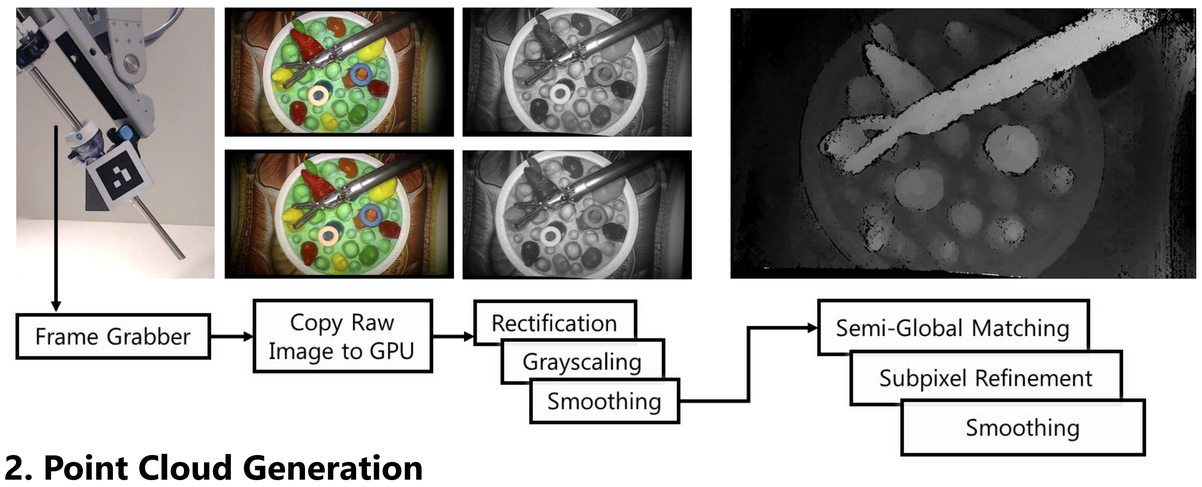
- Mainly via Head-Mounted Displays



1998 Fuchs et al. | 2018 Qian et al.

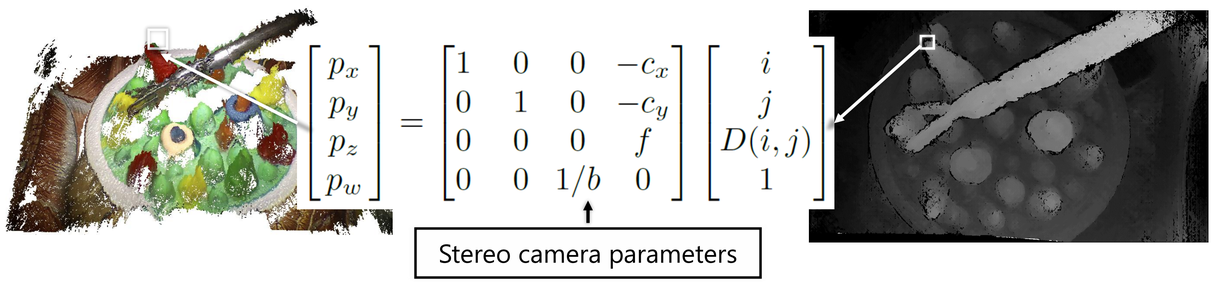
System Pipeline

1. Disparity Map from Stereo Laparoscope

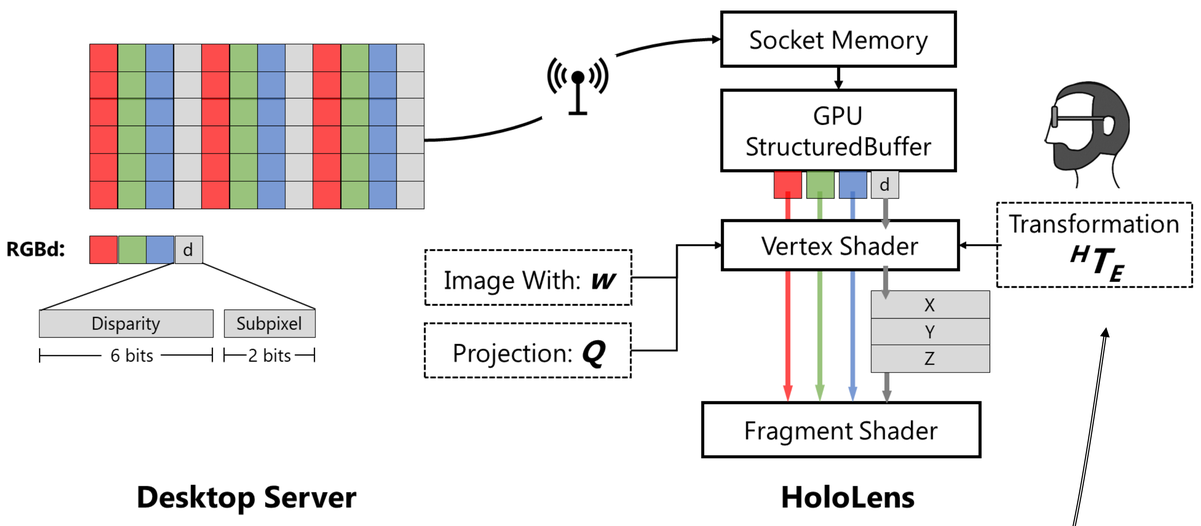


2. Point Cloud Generation

From disparity value **D(i, j)** to actual position **(x, y, z)**



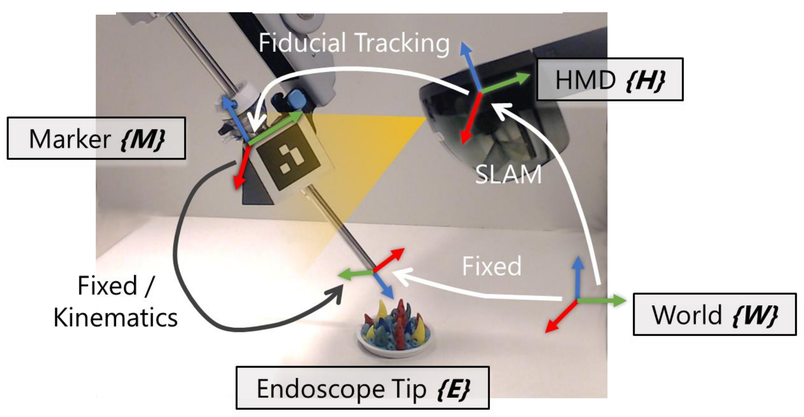
3. Point Cloud Rendering



4. Laparoscope Tracking

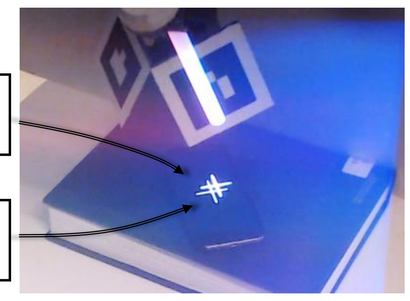
Sensor Fusion between SLAM and Fiducial Marker Tracking

$${}^{H}T_{E} = {}^{H}T_{W}\,{}^{W}T_{E} \qquad {}^{H}T_{E} = {}^{H}T_{M}\,{}^{M}T_{E}$$



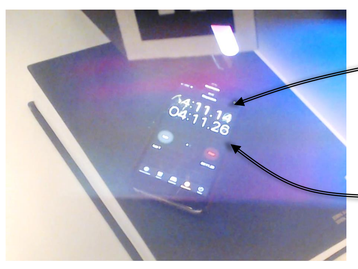
System Evaluation

1. Overlay Accuracy



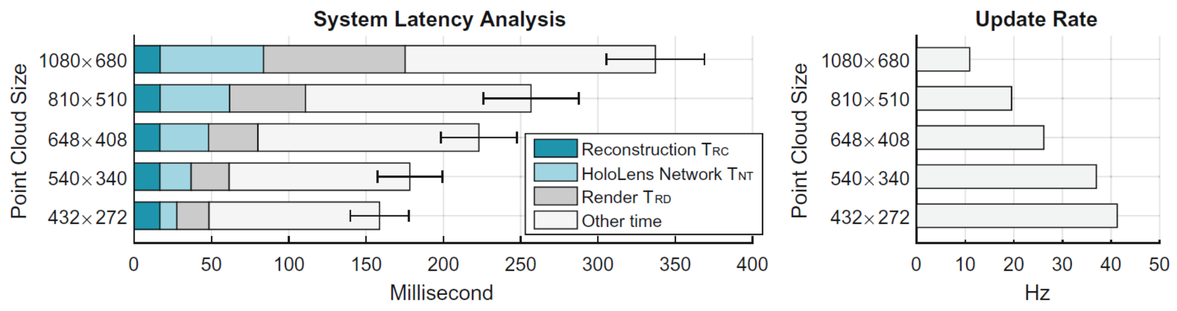
0.53 ± 0.15 °

2. End-to-End Latency and Framerate

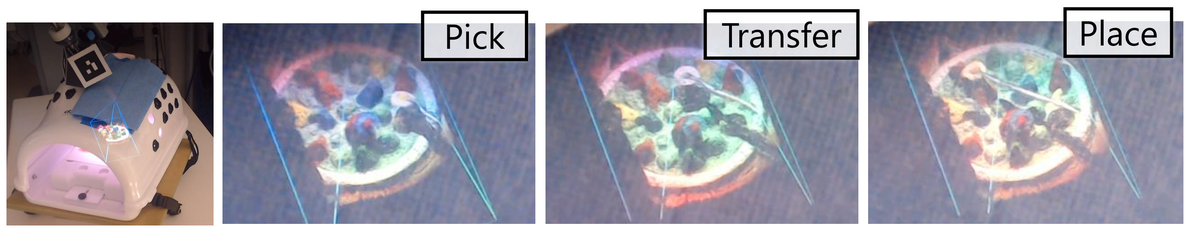


41.27 Hz

158.7 ms



User Study: Peg Transfer



- Traditional Laparoscopic v.s. ARAMIS
- 25 users (2 experts)
- 2 setup x 3 port x 2 repetition
- Results:
  - Completion time: **Comparable, better when the laparoscope setup is worse ergonomically**
  - NASA-TLX: **Significantly less physical demand and effort**
  - Questionnaire: **Significantly better hand-eye coordination**