Time-of-Flight Guided Endoscope Navigation Using Intelligent Assistance Systems

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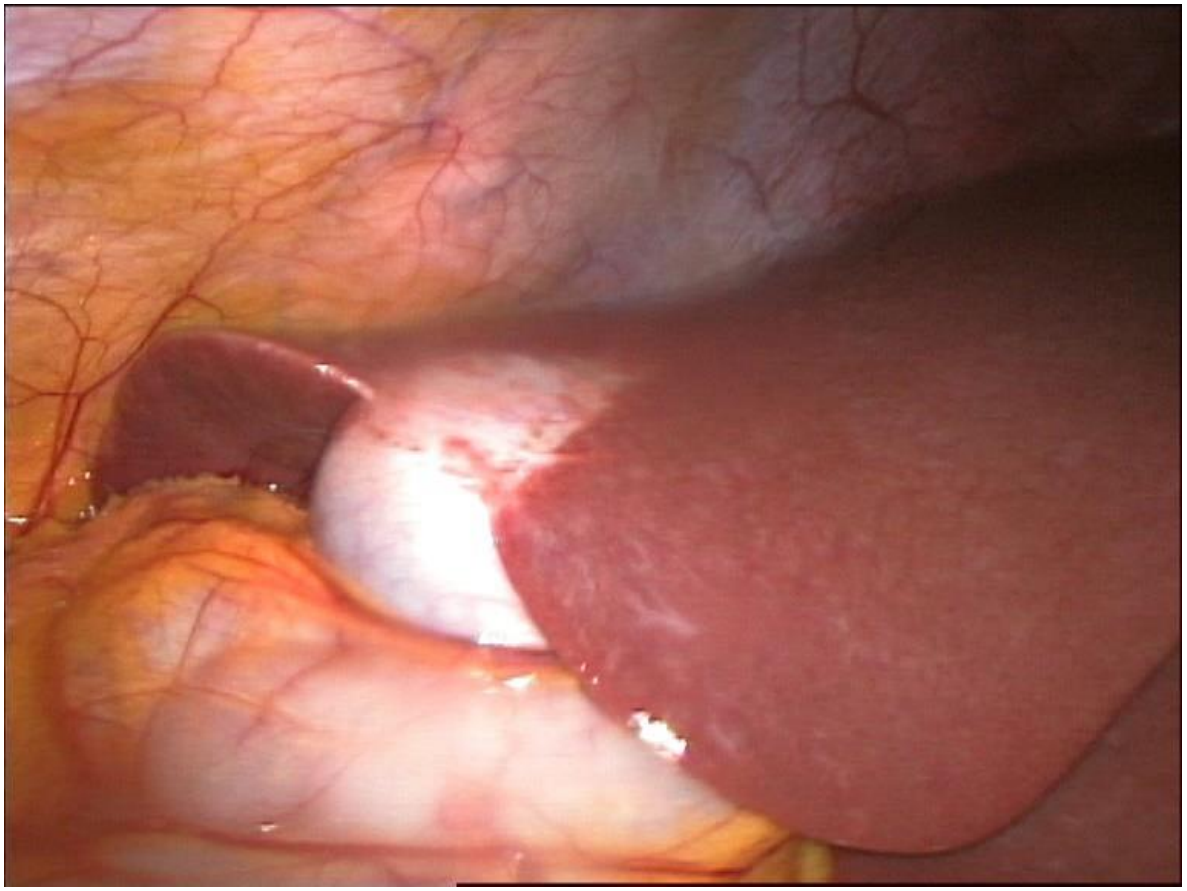
Outline

- Robotic Assistance Systems / Time-of-Flight
- Range Based Supervision Module
- Experiments
- Outlook

Conventional Endoscopic Interventions



wikipedia.org

Conventional Endoscopic Interventions

- Manual navigation of endoscope and instruments
  - Jitter may harm healthy tissue
  - Experience is important for orientation and avoidance of collisions
  - Lengthy interventions may lead to unstable video acquisition

mimis-obesity.com

- **Goal**: Combine a robotic assistance system with a supervision module to aid the navigation in minimally invasive surgery

Robotic Assistance Systems

- Indirect navigation by joysticks instead of direct manual navigation

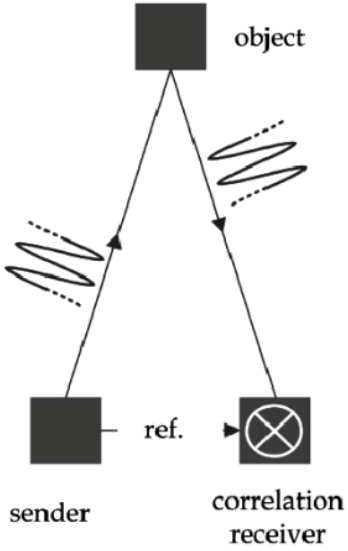
SOLOASSIST

EndoAssist

da Vinci Si System

Time-of-Flight

- Measurement of the phase shift between an emitted and the received (intensity-modulated) signal



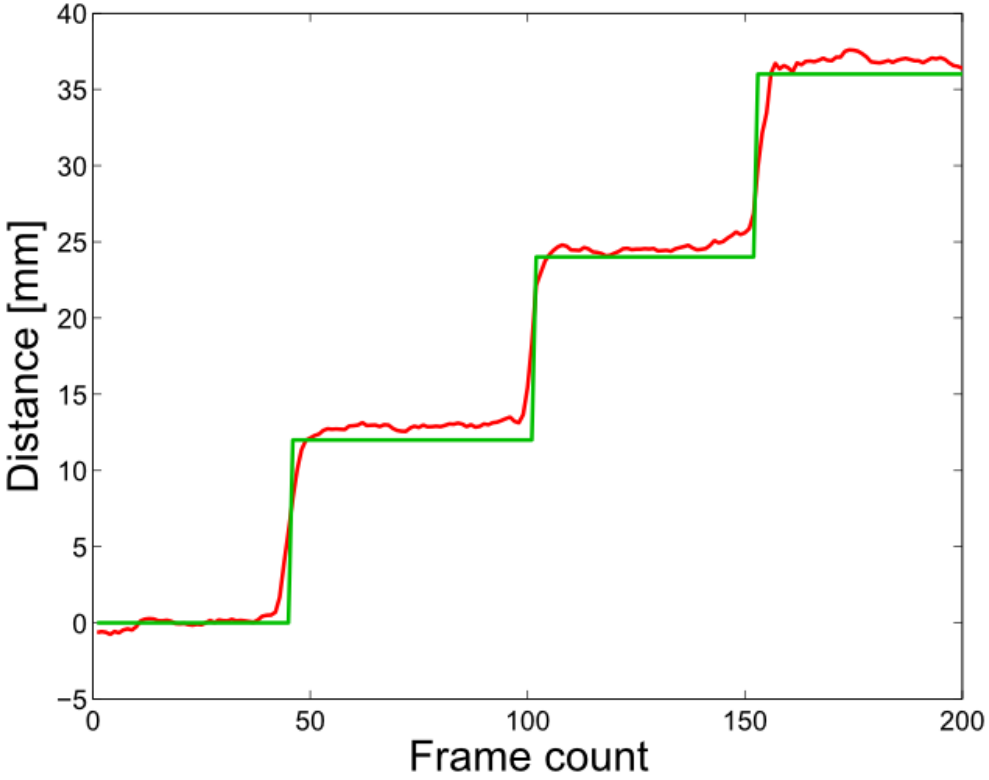
Time-of-Flight

- Decreasing camera dimensions allow Time-of-Flight sensors for MIS

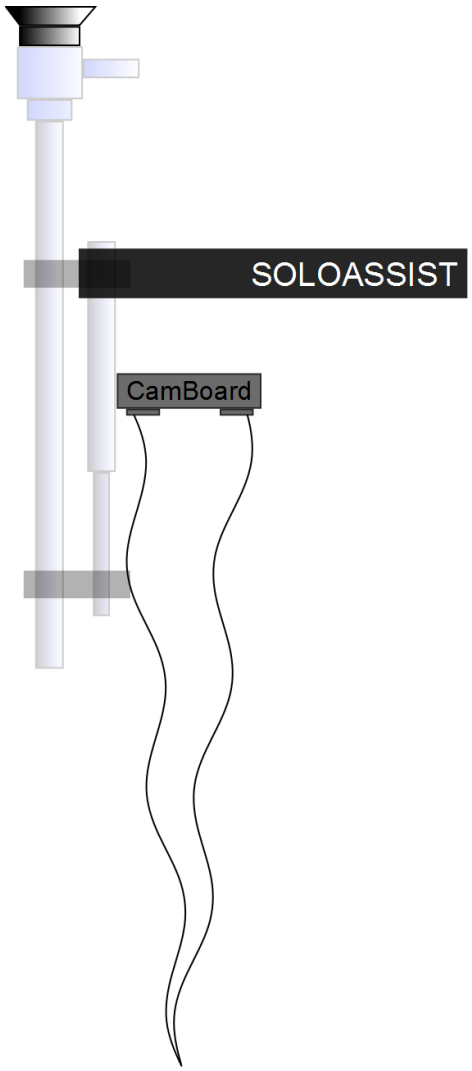
CamCube 3.0	CamBoard Nano	CamBoard Pico
194 x 60 x 75	37 x 30 x 25	85 x 15 x 8

Time-of-Flight

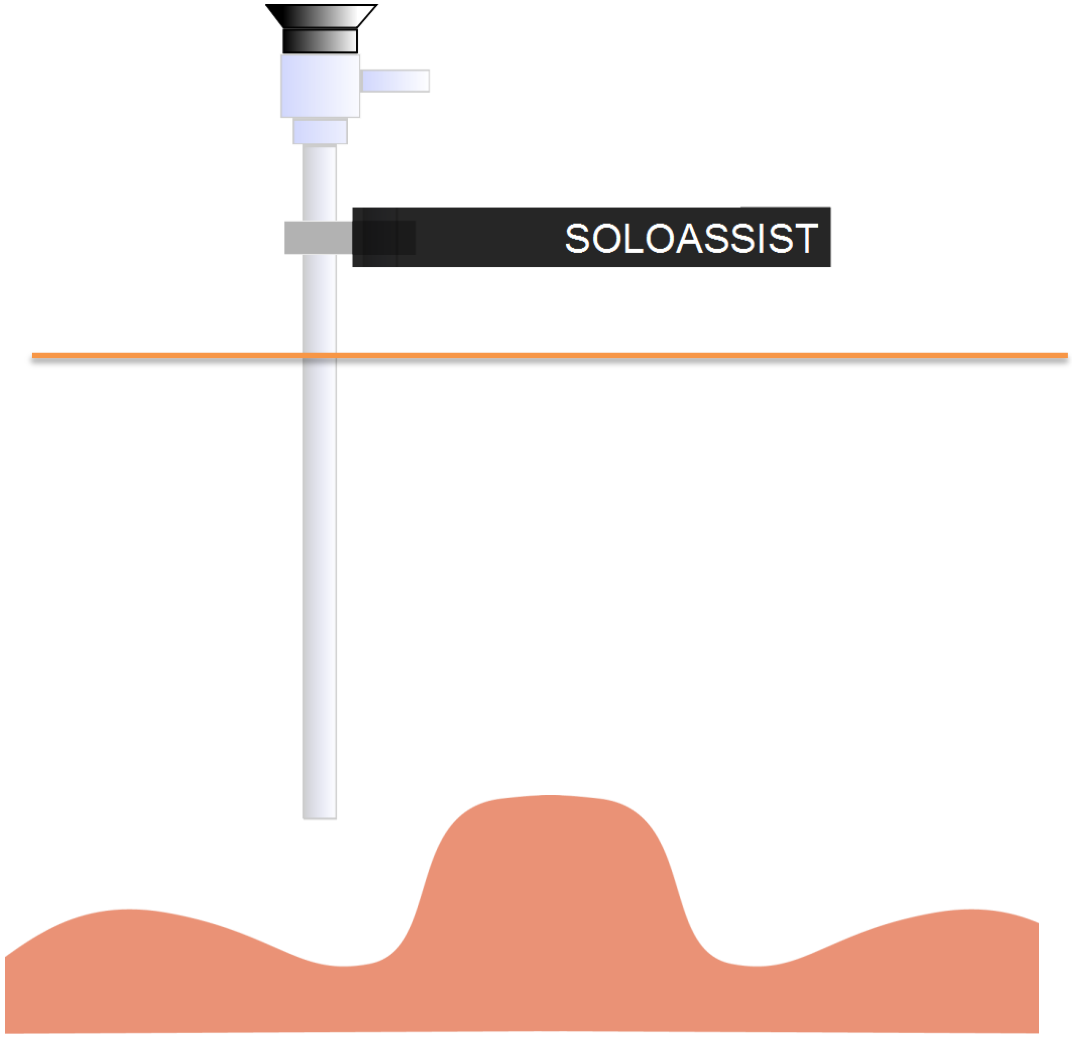
- Accuracy is sufficient for steps > 2mm
- Preprocessing: 4 frames averaged, bilateral filter

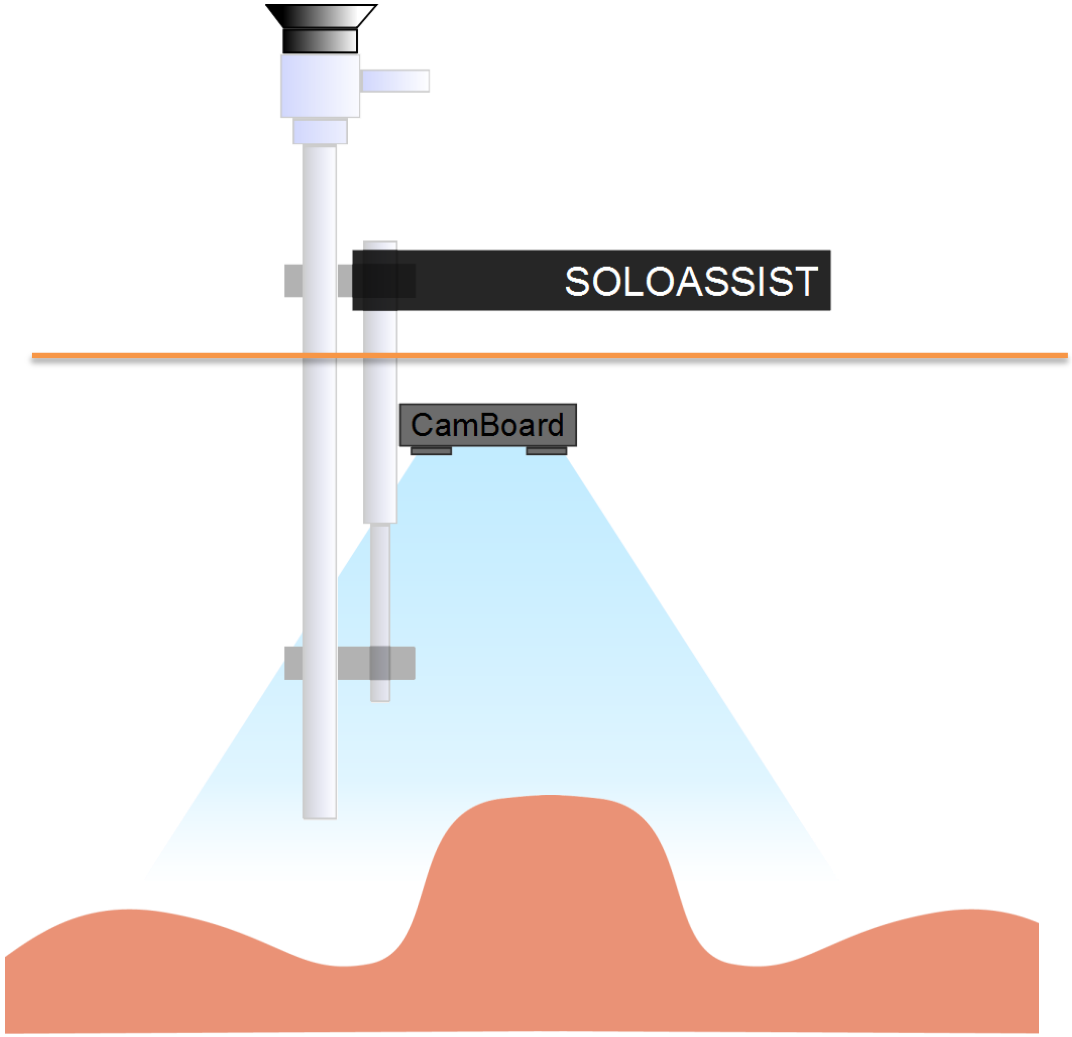


ToF Based Supervision Module



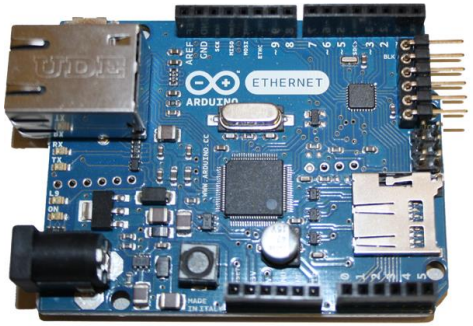
- Time-of-Flight range information for supervision
- Telescope servo motor to adjust distance
- SOLOASSIST to navigate laparoscope

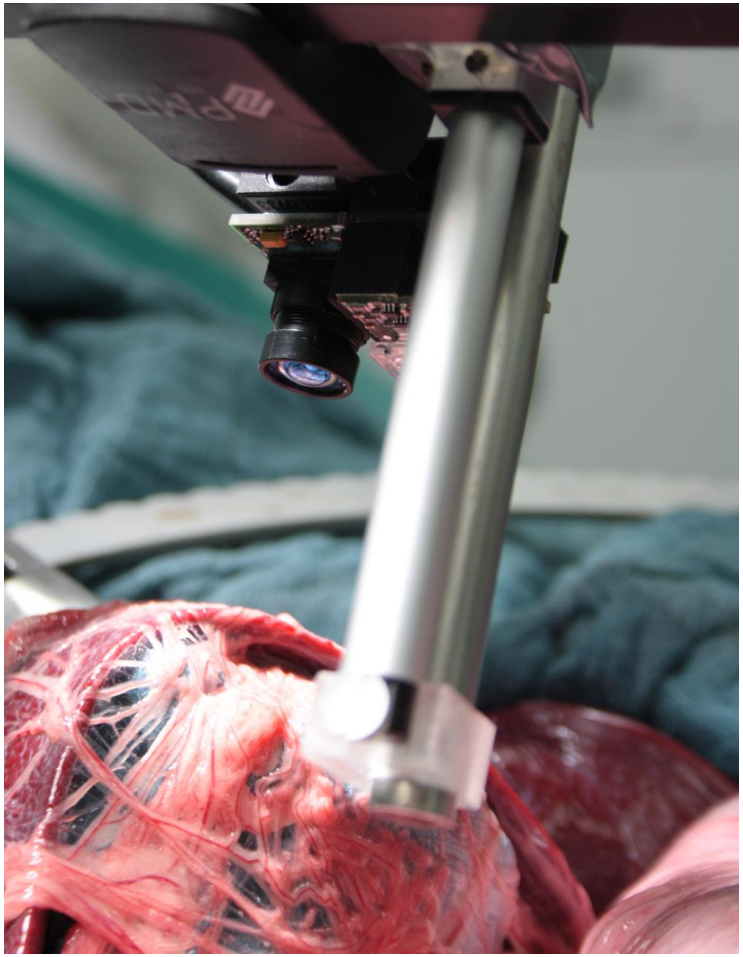

SOLOASSIST


SOLOASSIST
CamBoard

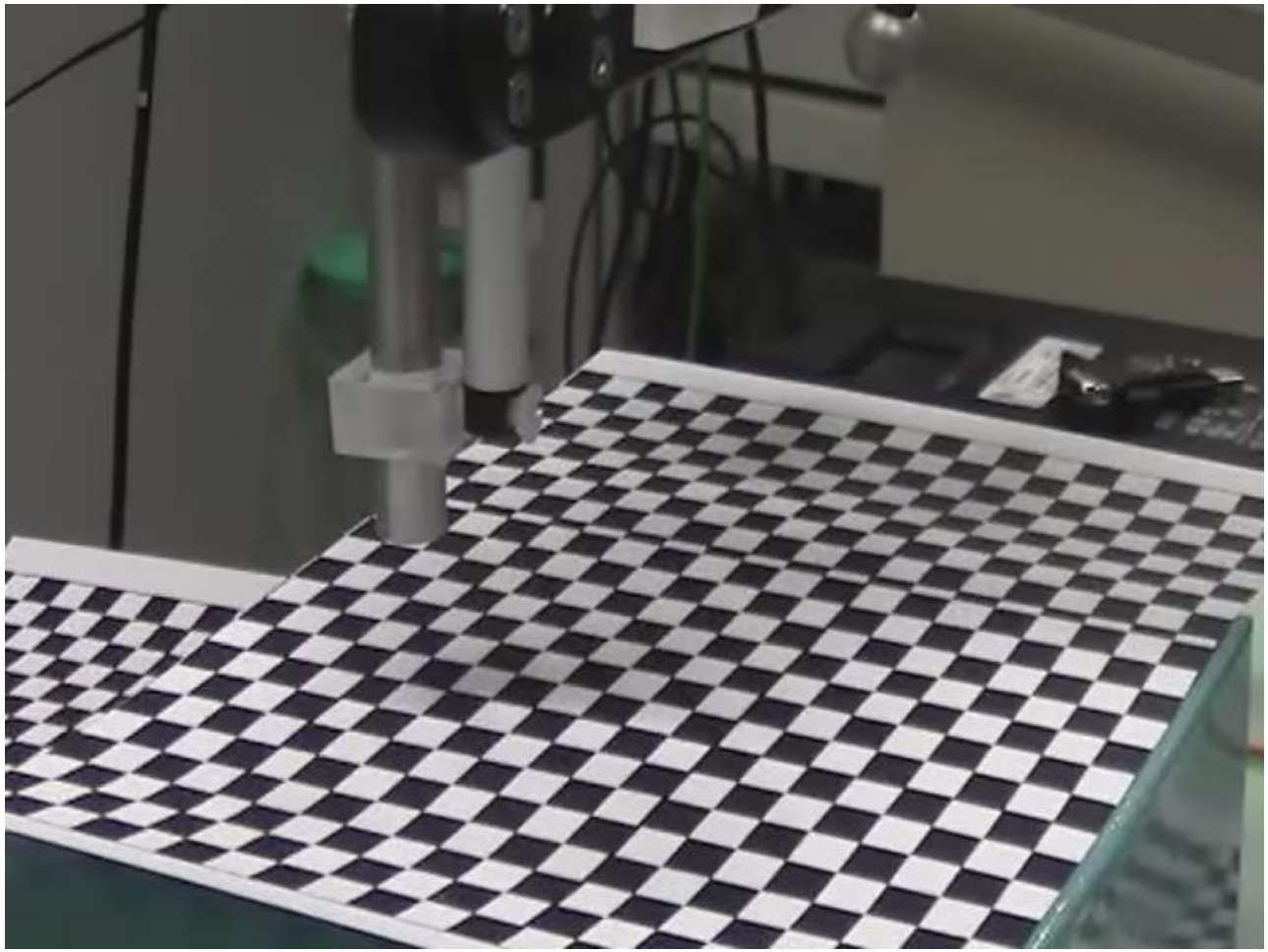
ToF Based Supervision Module

- PMD CamBoard Nano (160×120px)
- L12 linear servo motor
- Arduino Uno micro controller





ToF Based Supervision Module



ToF Based Supervision Module

ToF Based Supervision Module

Outlook

- Miniaturize the module for in-vivo experiments
- Improve the data quality by preprocessing
- Find a way to handle occlusions

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Thank you

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THE RANGE IMAGING TOOLKIT

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