CONTRIBUTIONS

A probe tracking system that is:
- Inexpensive
- Unobtrusive
- Robust to rigid patient motion

System Overview
1. Probe equipped with a camera
2. Camera tracking using artificial skin features (visual SLAM)
3. Camera-scan pose conversion

Scan to see a video showing the concept

METHODS: VISUAL SLAM (Simultaneous Localization and Mapping)

Initialization stage
- Two-frame initialization using 2D-2D point correspondences

Tracking stage
- Continuous camera tracking using 2D-3D point correspondences

Extension stage
- Map extension using keyframes

NO

YES

METHODS: US CALIBRATION

Goal: find the ultrasound-to-camera transformation $T_{US\rightarrow Cam}$ using the constraints:

$$[X \ Y \ d]^T = T_{Cam\rightarrow US}[u \ v \ 0 \ 1]^T$$

($T_{world}$ from camera extrinsic calibration)

IN-VITRO SCAN: EMBEDDED CYLINDERS

phantom
- Planar (+2.65% volume error)
- Curved (+6.30% volume error)

camera & scan trajectories

IN-VIVO SCAN: FEMORAL ARTERY

Scan region with artificial skin features (transparent dressing + temporary tattoo sticker)
Scan trajectories and 3D reconstruction of the femoral artery. Potential error sources include tracking inaccuracies and probe compression.

Scan to see related work

Scan to see a video showing the concept

Thank you.