NSF Engineering Research Center for Computer Integrated Surgical Systems and Technology

PAPER PRESENTATION

Team-14

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WHITING SCHOOL OF ENGINEERING
THE JOHNS HOPKINS UNIVERSITY

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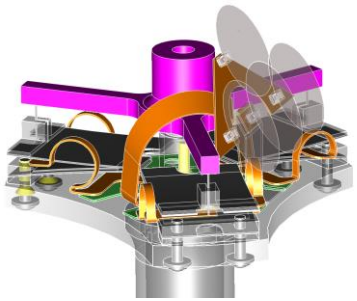
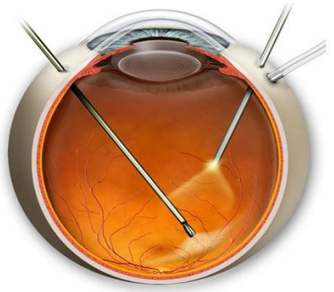
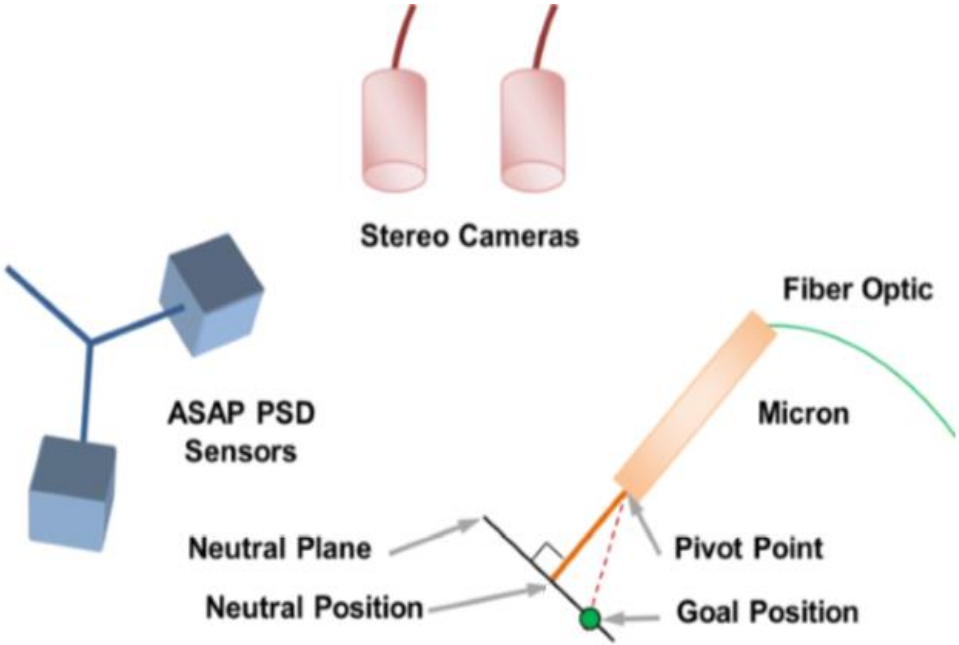
SUMMARY

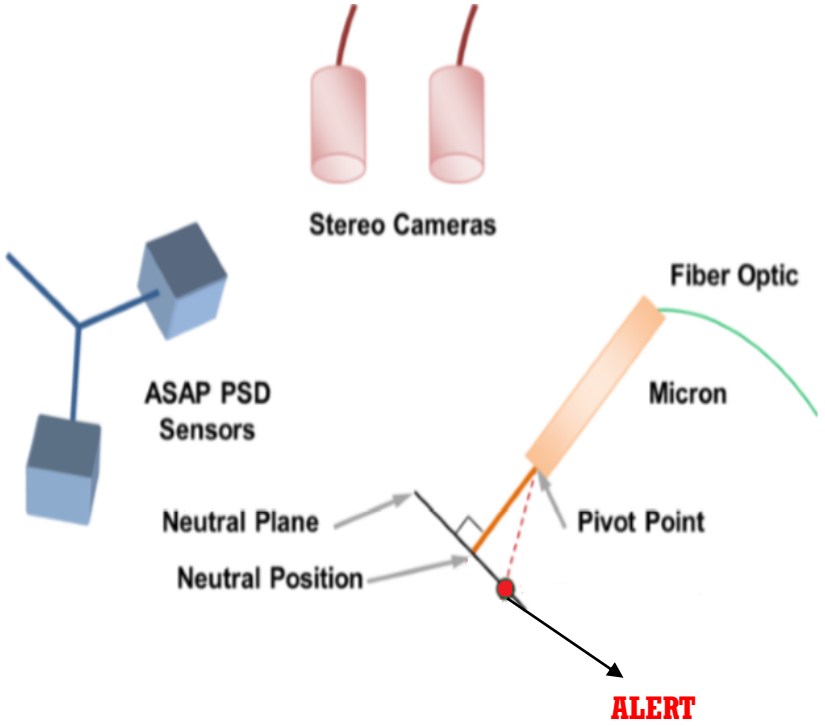
- Need :- Surgeons don't always know the position of the micron in its range of motion
- Goal :- Develop a visual alert assistance system for the surgeons dealing with very small anatomy.





SOLUTION


Stereo Cameras
Fiber Optic
ASAP PSD
Sensors
Micron
Neutral Plane
Pivot Point
Neutral Position
Goal Position


Stereo Cameras
Fiber Optic
ASAP PSD
Sensors
Micron
Neutral Plane
Pivot Point
Neutral Position
ALERT

PAPER SELECTION

- **Title** : Handheld Micromanipulation with Vision-Based Virtual Fixtures

- **Authors** : B.C. Becker, R.A. MacLachlan, G.D. Hager, and C.N. Riviere.

- **Purpose :** Derive a simple position-based virtual fixture framework for handheld micromanipulators such as Micron.

WHY THIS PAPER ?

- **Importance**
  - Virtual fixtures and tremor suppression are some of the major advantages of micron.
  - Helpful during medical procedures like vitreoretinal microsurgery.

- **Relevance**
  - Help understand the micron behavior.
  - Help to know better about the motion of the micron.

KEY POINT

LABORATORY FOR Computational Sensing + Robotics
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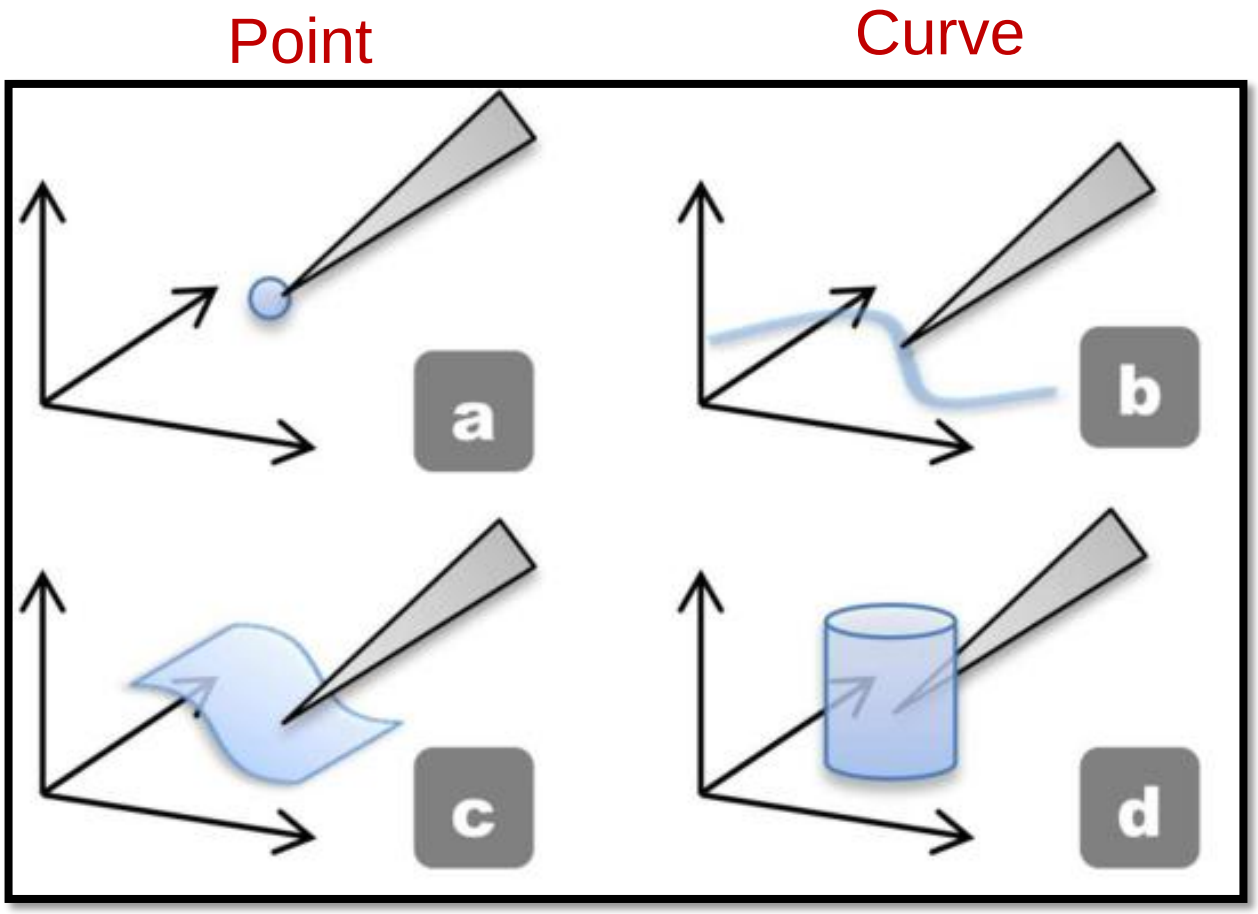
"Robotic control aids for micromanipulation can be grouped into three categories: tremor compensation, motion scaling, and virtual fixtures"

VIRTUAL FIXTURES



VIRTUAL FIXTURE

- $P_G = M_O(\mathbf{V}, P_N)$

where,

P_G = Goal point

M_O = Orthogonal projection Mapping

$\mathbf{V}$ = Virtual fixture

P_N = Null position

TREMOR SUPPRESSION

- $P_G = M_O(\mathbf{V}, F_T^n(P_N))$

where,

P_G = Goal point

M_O = Orthogonal projection Mapping

$\mathbf{V}$ = Virtual fixture

P_N = Null position

F_T = Tremor suppression filter

MOTION SCALING

- $\boldsymbol{P_T} = \boldsymbol{P_G} + \lambda e$

where,

$\boldsymbol{P_G}$ = Goal point

$\boldsymbol{P_T}$ = Micron Tip

λ = Scaling factor

e = Error between $\boldsymbol{P_N}$ and $\boldsymbol{P_G}$ on the virtual fixture

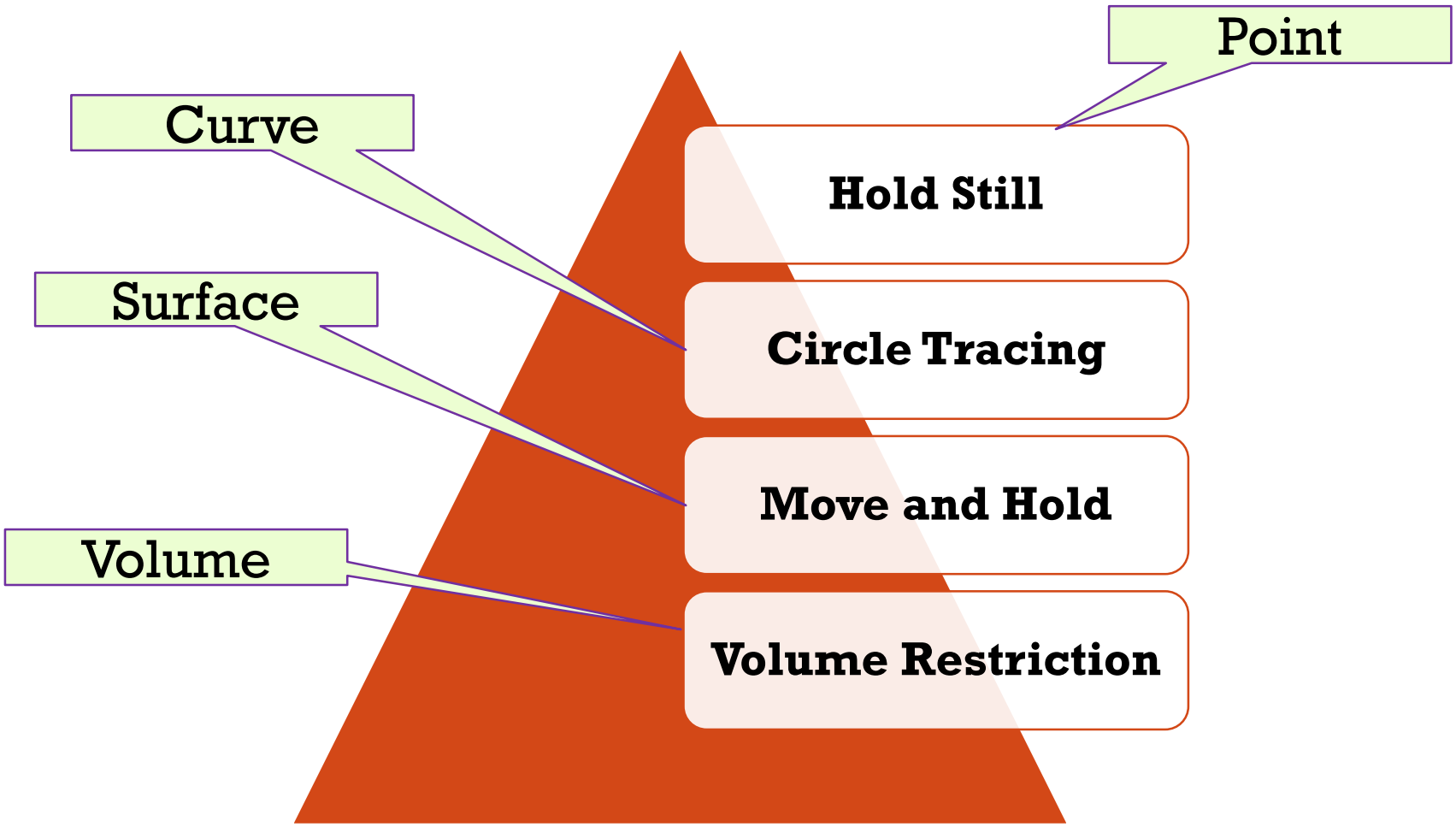
CONTROL FLOW

$$P_G = M_O(\mathbf{V}, F_T^n(P_N))$$

$$\mathbf{e} = F_T(P_N) - P_G$$

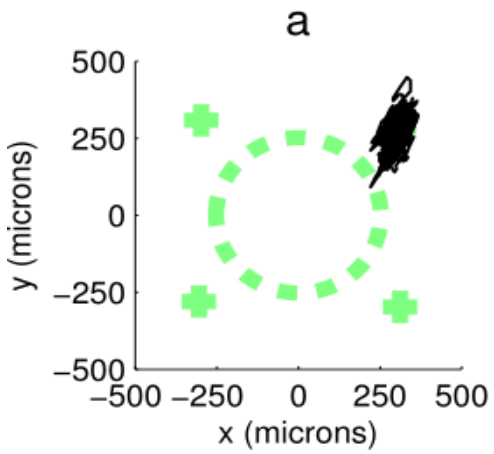
$$P_T = P_G + \lambda \mathbf{e}$$

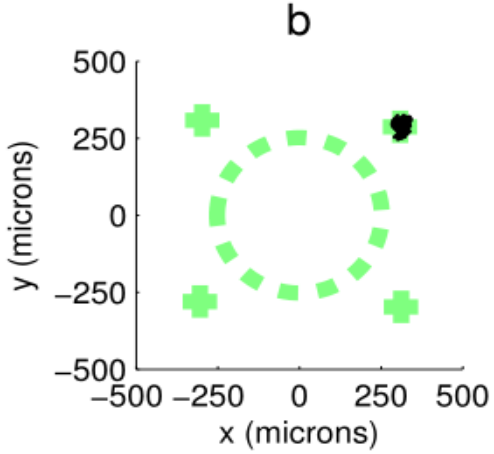
EXPERIMENTS



RESULT : HOLD STILL

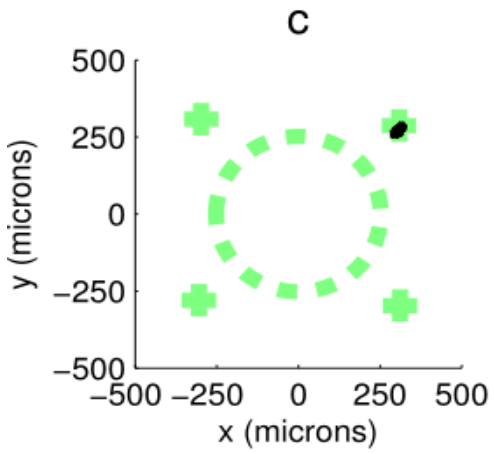
UAID

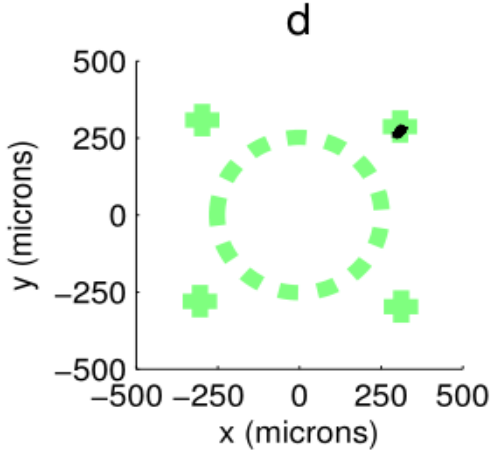




FLTR

SOFT-VF





HARD-VF

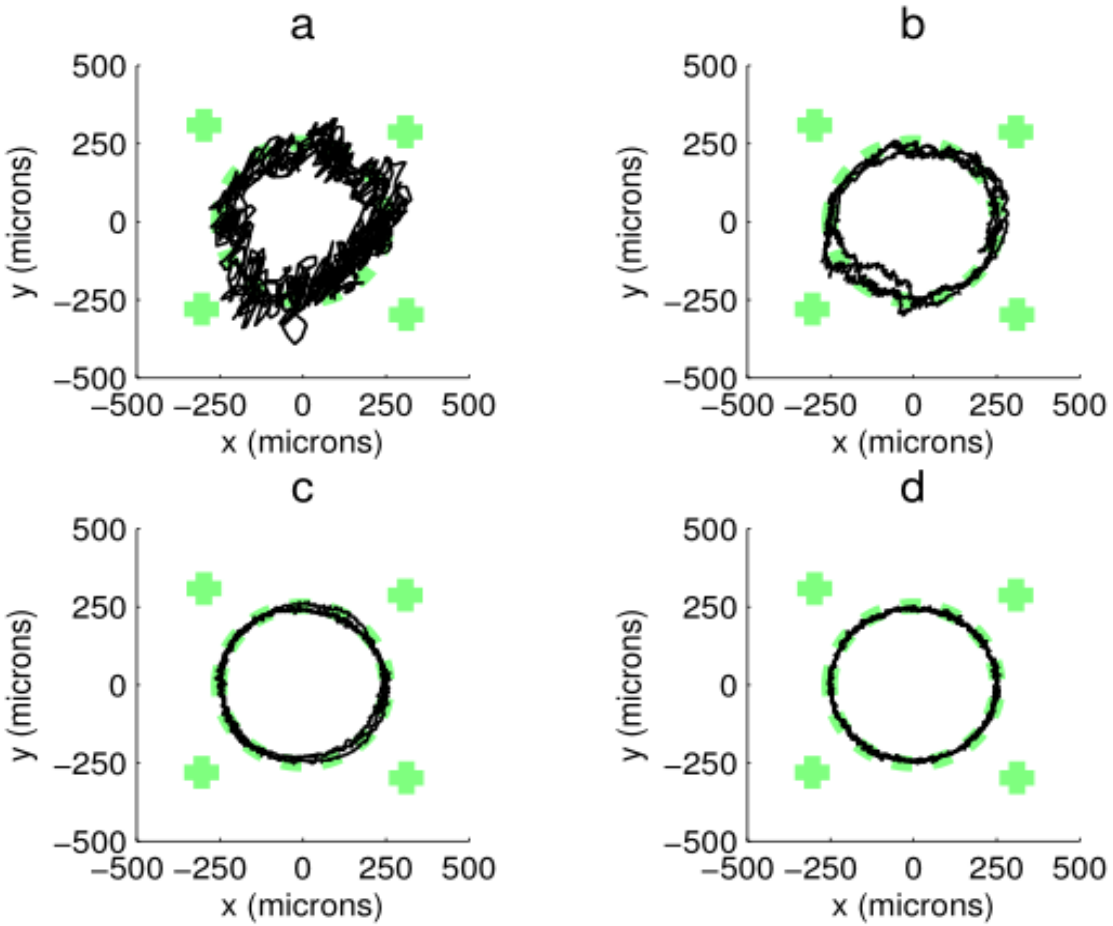
RESULT : CIRCLE TRACING

UAID

FLTR

SOFT-VF

HARD-VF



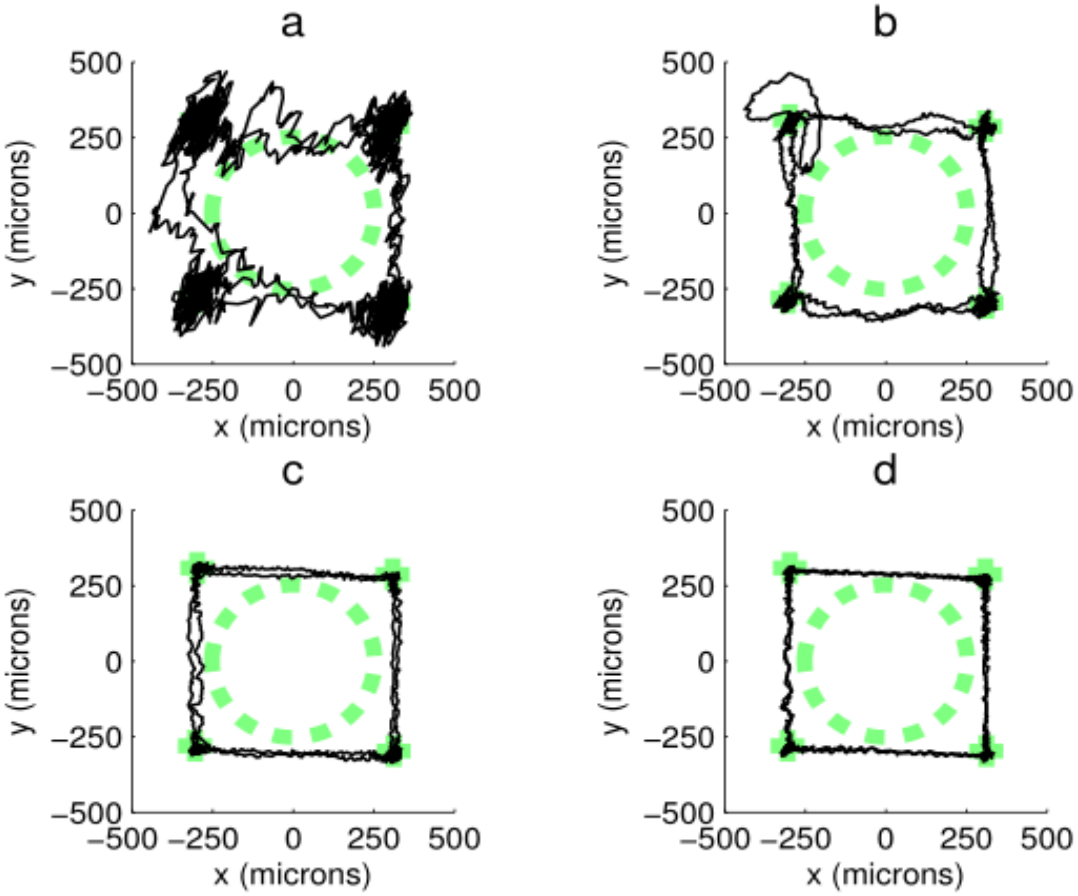
RESULT : MOVE AND HOLD

UAID

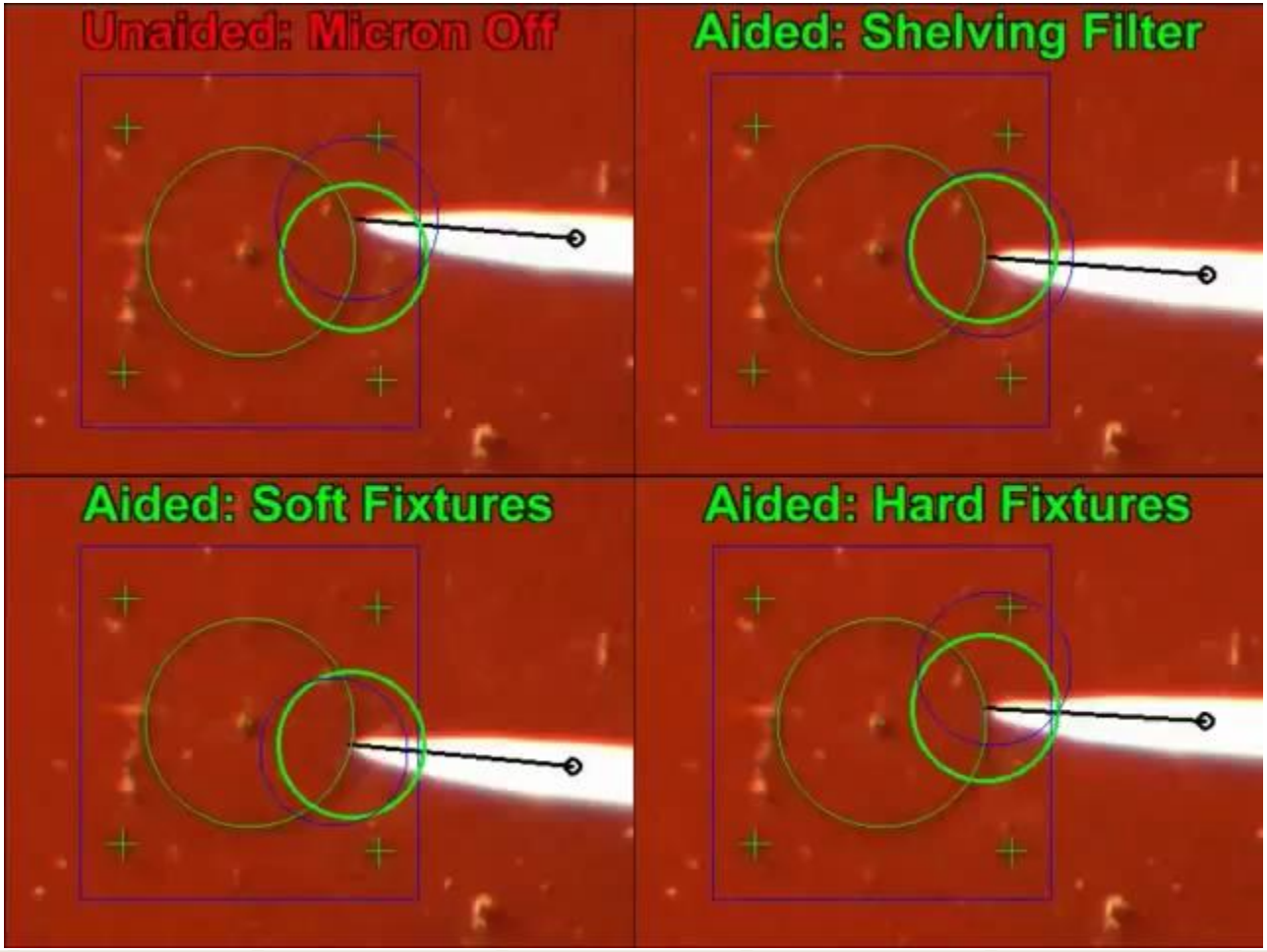
FLTR

SOFT-VF

HARD-VF



RESULT : CIRCLE TRACING



EVALUATION

- Repeated Micron Detail
- Elaborate Experiment details ??

FUTURE WORK

- Implement in vitreoretinal microsurgery
- Generalize the formulation of virtual fixtures to parameterizable subspaces .
- Interface to communicate with micron and provide visual feedback.

QUESTIONS?