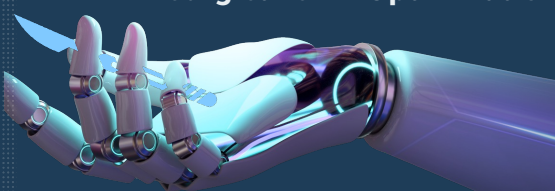




## Artificial Intelligence Driven Surgical Skill Optimization





**SHAMEEMA SIKDER, MD**  
 L. Douglas Lee & Barbara Levinson-Lee  
 Professorship of Ophthalmology  
 Director, Center of Excellence for  
 Surgical Training and Education




1

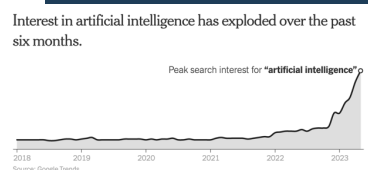
## Disclosures

- IP protection filed by Johns Hopkins

2



Interest in artificial intelligence has exploded over the past six months.



Peak search interest for "artificial intelligence"

Source: Google Trends

3

# Are all surgeons created equally?

4

### Meet our team



**WILMER EYE INSTITUTE**  
Shameema Sikder, MD



**MALONE CENTER FOR HEALTHCARE IN ENGINEERING**  
S. Swaroop Vedula, MBBS, PhD  
Daniel Khashabi, PhD  
Gregory Hager, PhD



**WHITING SCHOOL OF ENGINEERING**  
Vishal Patel, PhD

5

## Objectives

Review methods of surgical skill assessment

Discuss AI technology for assessment of skill

6

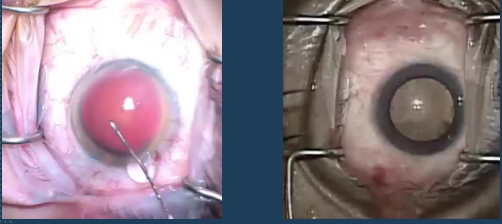
**AI will not replace the surgeon.**

**However the surgeon who understands HOW to leverage AI will replace the one who doesn't.**

-SHAMEEMA SIKDER, MD

7

**Who will you pick as your surgeon?**

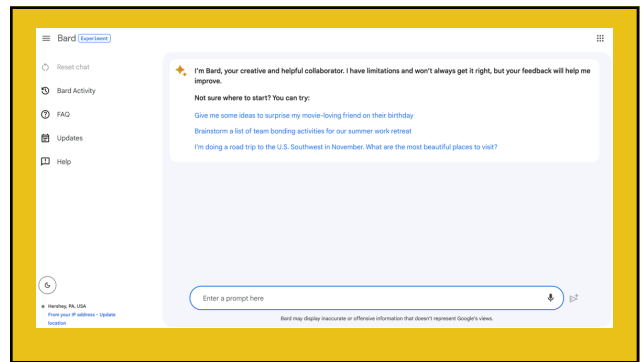


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**What makes a good surgeon?**



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**What makes a good surgeon?**

There are many qualities that make a good surgeon. Some of the most important include:

- **Technical skills:** Surgeons must have excellent hand-eye coordination and manual dexterity. They must be able to make precise movements with their hands and fingers, even under pressure.
- **Knowledge:** Surgeons must have a deep understanding of anatomy, physiology, and pathology. They must be able to identify and treat a wide range of surgical conditions.
- **Decision-making skills:** Surgeons must be able to make quick and accurate decisions under pressure. They must be able to weigh the risks and benefits of different treatment options and choose the best one for each patient.
- **Communication skills:** Surgeons must be able to communicate effectively with patients, their families, and other healthcare professionals. They must be able to explain complex medical concepts in a way that is easy to understand.
- **Empathy:** Surgeons must be able to empathize with their patients and understand their fears and concerns. They must be able to provide compassionate care and support during a difficult time.
- **Resilience:** Surgeons must be able to handle the stress and emotional demands of their job. They must be able to bounce back from setbacks and continue to provide high-quality care.

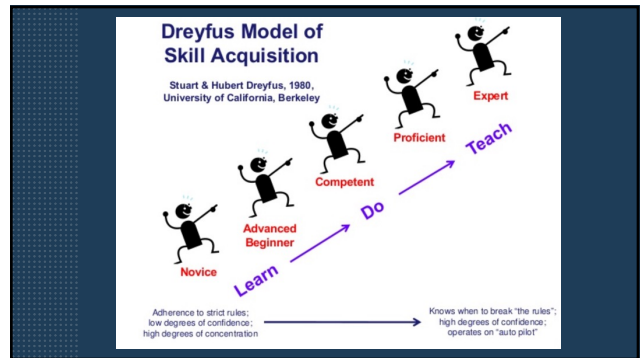
In addition to these qualities, good surgeons are also typically hard-working, dedicated, and passionate about their work. They are committed to providing their patients with the best possible care.

Bard AI by Google

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**Dreyfus Model of Skill Acquisition**

Stuart & Hubert Dreyfus, 1986, University of California, Berkeley



Adherence to strict rules; low degrees of confidence; high degrees of concentration

Knows when to break "the rules"; high degrees of confidence; operates on "auto pilot"

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### How does one become a good surgeon?

- **TRADITIONAL APPRENTICE MODEL:**
  - Natural skill
  - Opportunity to observe
- **CURRENT MODEL:**
  - Variable baseline skill
  - Structured training program
  - Assessment and Feedback



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### CURRENT RESOURCES AVAILABLE TO TRAINEES

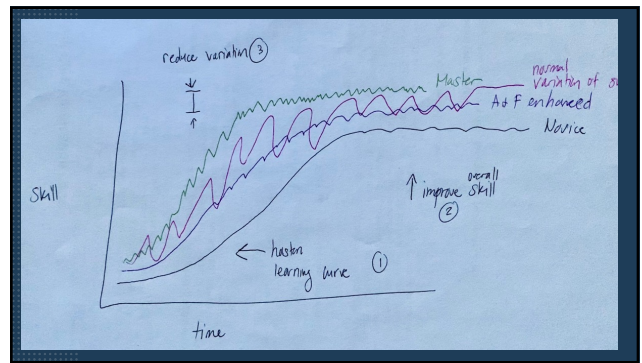


14

### Assessment and Feedback



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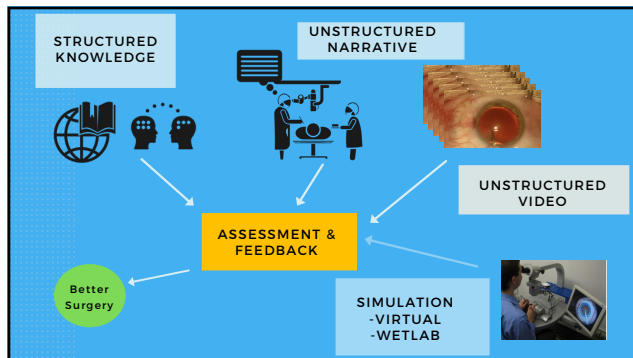
16

### How can skill be assessed intraoperatively?

17

### Human- Driven Surgical Skill Optimization

18



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## RUBRICS

**MULTIPLE RUBRICS AVAILABLE FOR ASSESSMENT OF SURGICAL TECHNICAL SKILL**

- OASIS & ICO-OSCAR:PHACO

**ADVANTAGES**

- QUICK
- VALIDATED
- AFFORDABLE (\$4000 IN ANNUAL COSTS)

**DISADVANTAGES**

- TIME-INTENSIVE
- RESOURCE-INTENSIVE
- SOME ELEMENT OF SUBJECTIVITY

Sikder et al. J Cataract Refract Surg (2014)

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# What about AI?

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WILL SURGEONS BE REPLACED BY ROBOTS?

Dr. Terminator

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Will AI replace surgeons?

It is unlikely that AI will completely replace surgeons in the near future. However, AI is likely to play an increasingly important role in surgery in the coming years. For example, AI can be used to:

- Assist surgeons during surgery: AI-powered surgical robots can help surgeons make more precise incisions and reduce the risk of complications.
- Diagnose diseases: AI can be used to analyze medical images and data to help surgeons diagnose diseases more accurately.
- Personalize care: AI can be used to analyze a patient's medical history and other data to personalize their care.

Overall, AI has the potential to improve the quality of care that surgeons can provide. However, it is important to remember that AI is a tool, and it is still under development. Surgeons will still be needed to make critical decisions and provide compassionate care to their patients.

Bard AI by Google

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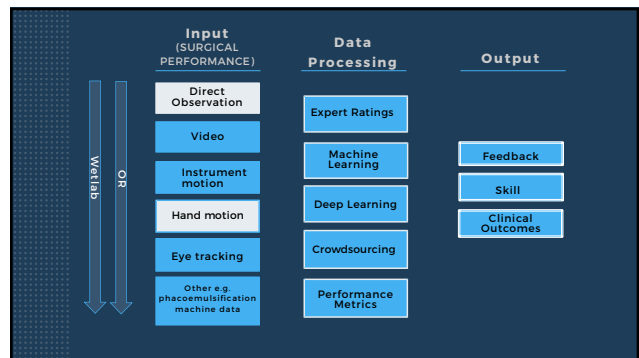
WILL SURGICAL EDUCATORS BE REPLACED BY AI?

MAYBE A LITTLE BIT??

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# AI-Driven Surgical Skill Optimization

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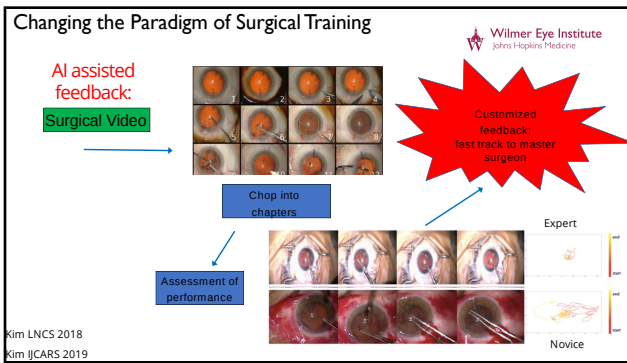
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# Our Approach

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## How do we get started?

- Can we use a crowd to annotate instrument labels on surgical videos?

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### Crowdsourcing Annotation of Surgical Instruments in Videos of Cataract Surgery

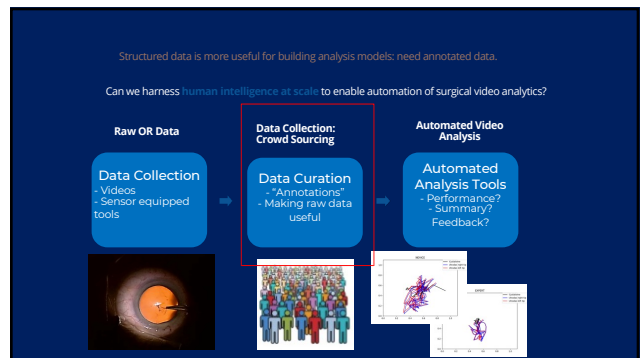
Tae Soo Kim<sup>1</sup>, Anand Malpani<sup>2</sup>, Austin Reiter<sup>1</sup>, Gregory D. Hager<sup>1,2</sup>, Shamoema Sikder<sup>3(OR)</sup>, and S. Swaroop Vedula<sup>2</sup>

<sup>1</sup> Department of Computer Science, Johns Hopkins University, Baltimore, MD, USA  
<sup>2</sup> The Malone Center for Engineering in Healthcare, Johns Hopkins University, Baltimore, MD, USA  
<sup>3</sup> Wilmer Eye Institute, Johns Hopkins University School of Medicine, Baltimore, MD, USA

Demonstrate reliability and validity of crowdsourced annotations for information on surgical instruments.

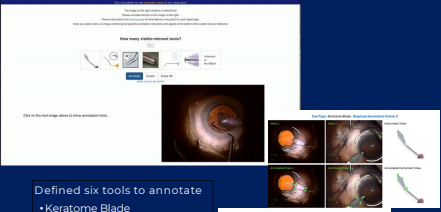
LABELS 2018, CVII 2018, STENT 2018

35



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### Data Collection



Defined six tools to annotate

- Keratome Blade
- Cystotome
- Utradas
- Irrigation/Aspiration Cannula
- Anterior Chamber Cannula
- Phaco Probe

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### Consistency in Crowd Annotations

Collected 200 images from 2 procedures, 9 annotations per image, under 48 hours.

Overall consistency

	N Agreement	Fleiss' Kappa
n=9	0.9222	0.6276

Per-tool consistency

	Keratome	Cystotome	Utradas	IA	A/C Cannula	Phaco
	1.000	0.7847	0.9683	0.7531	0.9350	0.8344

IA: Irrigation/Aspiration Cannula  
A/C: Anterior Chamber

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### Accuracy of the Crowd


Collected 200 images from 2 procedures, 9 annotations per image, under 48 hours.

Overall accuracy

	Accuracy
n=9	0.8737

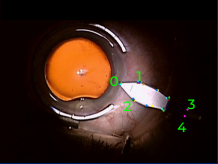
Per-tool accuracy among the crowd

	Keratome	Cystotome	Utradas	IA	A/C Cannula	Phaco
	1.000	0.375	1.000	0.911	0.957	1.000



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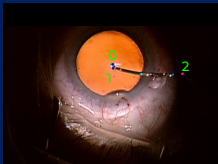
### Key Points: Crowd can localize tool tips very consistently and accurately



Keypoint Index	Average Error (pixel)	Std (pixel)
0	3.2074	1.9673
1	10.2815	13.5040
2	9.7022	14.2929
3	25.7543	31.2627
4	25.7088	30.5819

40

### Key Points: Crowd can localize tool tips very consistently and accurately




Keypoint Index	Average Error (pixel)	Std (pixel)
0	4.3492	2.9023
1	115.5040	106.2710
2	38.5125	41.8359

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### Summary

We can harness human intelligence reliably and accurately at scale to analyze surgical videos.

Applications include automated objective surgical skill assessment, directed feedback and coaching.



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## Conclusions

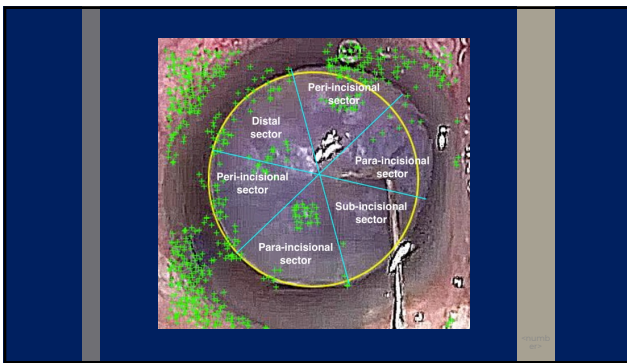
- Tool identification: Inter-rater agreement of 0.63 (Fleiss' kappa)
- Accuracy of 0.88 for identification of instruments compared against an expert annotation.
- Crowdsourcing can be effectively used to identify instruments in a surgical video

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## Now what?

- We can get a crowd to annotate instrument labels on surgical videos
- How much granular detail can we gather within a step using instrument motion?

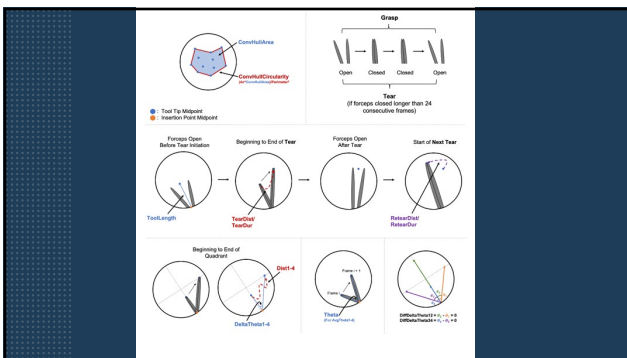
44



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## Now what?

- We can get a crowd to annotate instrument labels and tips on surgical videos
- What step should we next focus?

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> J Cataract Refract Surg, 45 (11), 1682-1683 Nov 2019

## Can We Efficiently Use Structured Rating Scales to Objectively Assess Global Technical Skill in Cataract Surgery?

Kapil Mishra, Sidra Zafar, S Swaroop Vedula, Shameema Sikder  
 PMID: 31706522 DOI: 10.1016/j.jcrs.2019.07.030

49

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### IS TIME A VALID MEASURE OF SKILL?

PROCEDURE SPEED IS OFTEN USED AS A PROXY FOR EXCELLENCE

FASTER SURGEONS ARE REGARDED AS BETTER SURGEONS

TIME HAS BEEN USED FOR QUANTIFYING SKILL IN JUNIOR AND EXPERIENCED SURGEONS

SCHENK T, MAE HHS (2015)  
 VAN ROOY KJ, AL SAHAFI Z (2018)

51

Operative Time predicts appointment status & is not of much utility to assess surgical technical skill in cataract surgery

### OBJECTIVE ASSESSMENT OF TECHNICAL SKILL TARGETED TO TIME IN CATARACT SURGERY

Ground Truth	AUC
Appointment - Quadrants	0.77 (0.66 to 0.87)
Appointment - Time	0.74 (0.64 to 0.84)
Global-SI4 - Quadrants	0.53 (0.41 to 0.65)
Global-SI4 - Time	0.51 (0.39 to 0.63)
Rhexis-SI4 - Quadrants	0.54 (0.44 to 0.64)
Rhexis-SI4 - Time	0.58 (0.47 to 0.69)

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### Next?

- We can get a crowd to annotate instrument labels on surgical videos
- Capsulorhexis is a good step on which to focus.
- Can we automate phase detection?

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JAMA Network Open

Original Investigation | Ophthalmology

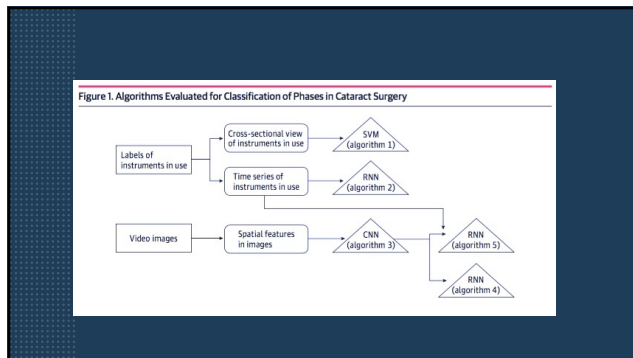
### Assessment of Automated Identification of Phases in Videos of Cataract Surgery Using Machine Learning and Deep Learning Techniques

Felix Yu, BS, Clarissa Silva Cross, BS, Tae Soo Kim, BS, Zung Song, Felix Parker, Gregory D. Hager, PhD, Austin Retter, PhD, S. Swaroop Vedula, MBBS, PhD, Hader Al, PhD, Shameema Sikder, MD

DEMONSTRATE MACHINE LEARNING AND DEEP LEARNING TECHNIQUES CAN YIELD TOOLS THAT EFFICIENTLY SEGMENT VIDEOS OF CATARACT SURGERY INTO CONSTITUENT PHASES FOR SUBSEQUENT AUTOMATED SKILL ASSESSMENT AND FEEDBACK.

JAMA Network Open, 2019

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Table 2. Summary Measures of Algorithm Performance for Phase Classification

Metric	SVM, Algorithm 1, Instrument Labels	RNN, Algorithm 2, Instrument Labels	CNN, Algorithm 3, Images	CNN-RNN, Algorithm 4, Images	CNN-RNN, Algorithm 5, Images and Instrument Labels
Unweighted accuracy (95% CI)	0.938 (0.937-0.939)	0.959 (0.958-0.960)	0.956 (0.954-0.957)	0.921 (0.920-0.923)	0.915 (0.913-0.916)
Frequency-weighted accuracy (95% CI)	0.935 (0.934-0.936)	0.957 (0.956-0.958)	0.955 (0.953-0.956)	0.919 (0.918-0.920)	0.913 (0.912-0.914)
Inverse variance-weighted accuracy (95% CI)	0.963 (0.962-0.965)	0.976 (0.975-0.978)	0.958 (0.957-0.960)	0.928 (0.926-0.930)	0.920 (0.918-0.922)
Unweighted AUC (95% CI)	0.737 (0.730-0.744)	0.773 (0.770-0.776)	0.712 (0.704-0.719)	0.752 (0.750-0.755)	0.737 (0.735-0.739)

Abbreviations: AUC, area under the receiver operating characteristic curve; CNN, convolutional neural network; RNN, recurrent neural network; SVM, support vector machine.

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### Conclusions

- Modeling time series of labels of instruments in use appeared to yield greater accuracy in classifying phases of cataract operations than modeling cross-sectional data on instrument labels, spatial video image features, spatiotemporal video image features, or spatiotemporal video image features with appended instrument labels.
- Time series models of instruments in use may serve to automate the identification of phases in cataract surgery, helping to develop efficient and effective surgical skill training tools in ophthalmology.

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### Making progress....

- We can get a crowd to annotate instrument labels on surgical videos
- We can get a machine to identify the correct phase of surgery with the labels
- What about assessing performance?

58

International Journal of Computer Assisted Radiology and Surgery  
<https://doi.org/10.1007/s11548-019-01956-8>

ORIGINAL ARTICLE

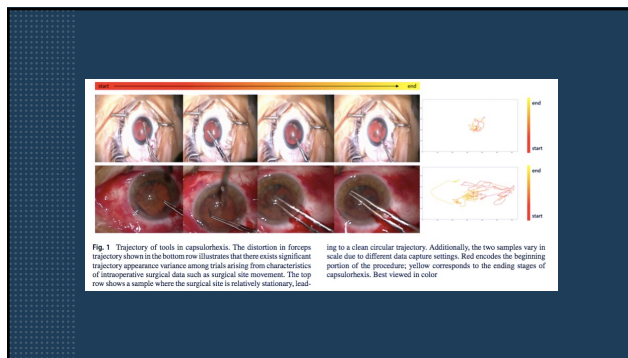
**Objective assessment of intraoperative technical skill in capsulorhexis using videos of cataract surgery**

Tae Soo Kim<sup>1</sup> · Molly O'Brien<sup>1</sup> · Sidra Zafar<sup>2</sup> · Gregory D. Hager<sup>1</sup> · Shameema Sikder<sup>2</sup> · S. Swaroop Vedula<sup>1</sup>

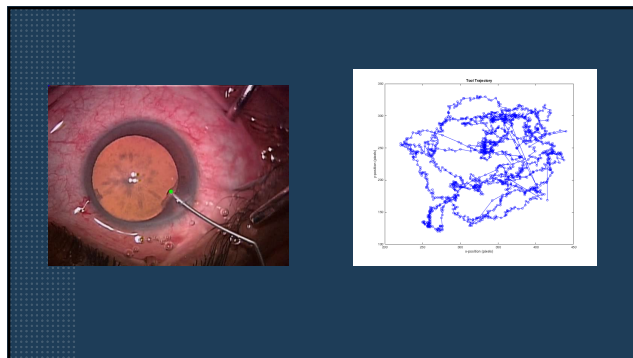
Received: 1 February 2019 / Accepted: 27 March 2019  
 © ICARS 2019

DEVELOP AND VALIDATE DEEP LEARNING TECHNIQUES FOR TECHNICAL SKILL ASSESSMENT USING VIDEOS OF THE SURGICAL FIELD.

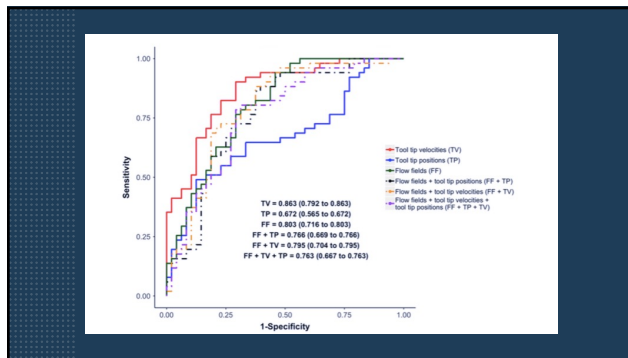
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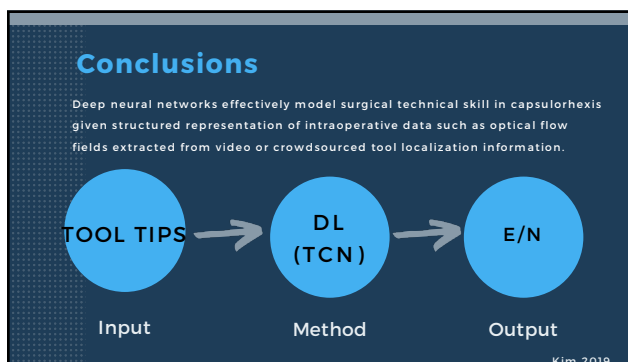


62

Representation	Fold 1	Fold 2	Fold 3	Fold 4	Fold 5	Accuracy across folds
TV	0.789	0.737	<b>0.842</b>	<b>1.000</b>	<b>0.870</b>	<b>0.848 (0.770 to 0.926)</b>
TP	0.526	0.632	0.632	0.789	0.565	0.629 (0.579 to 0.679)
FF	0.684	0.684	0.474	0.632	0.696	<b>0.634 (0.561 to 0.707)</b>
FF + TP	0.789	0.684	0.632	0.632	0.696	0.686 (0.636 to 0.736)
FF + TV	0.737	<b>0.789</b>	0.632	0.632	0.696	0.696 (0.644 to 0.751)
FF + TP + TV	<b>0.842</b>	0.632	0.684	0.684	0.696	0.708 (0.646 to 0.770)

FF flow fields, TP tool tip positions, TV tool tip velocities  
 Bold values indicate highest observed value

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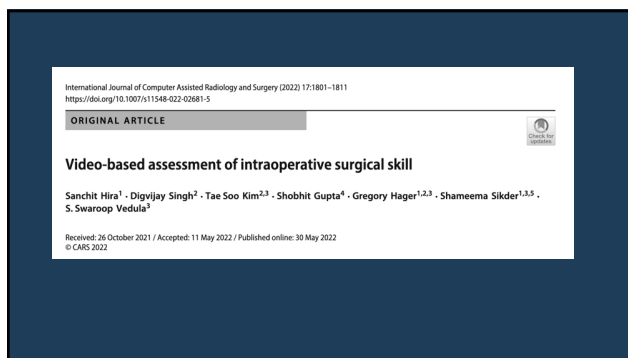


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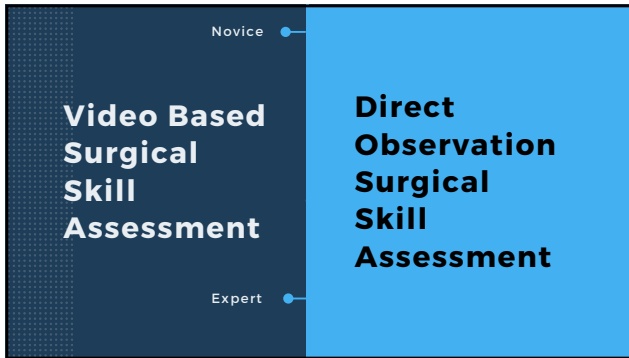
### What next??

- Automate instrument labeling
- Automate chaptering
- Increase robustness of current automated analysis
- Facilitate data flow

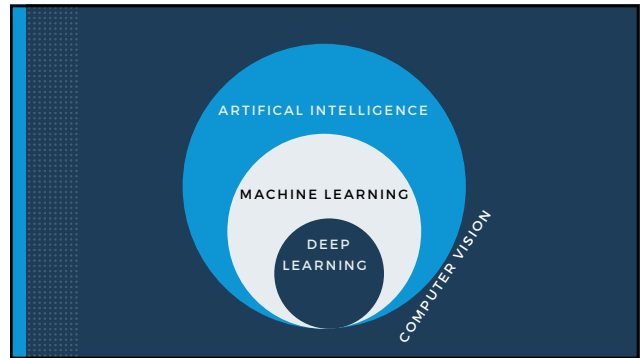
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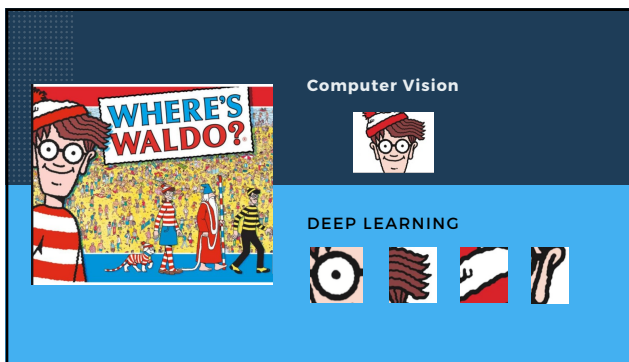
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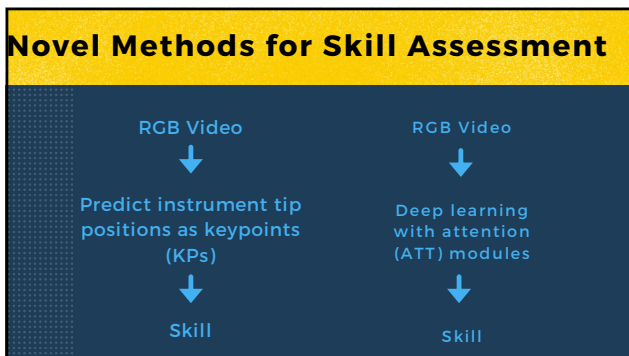
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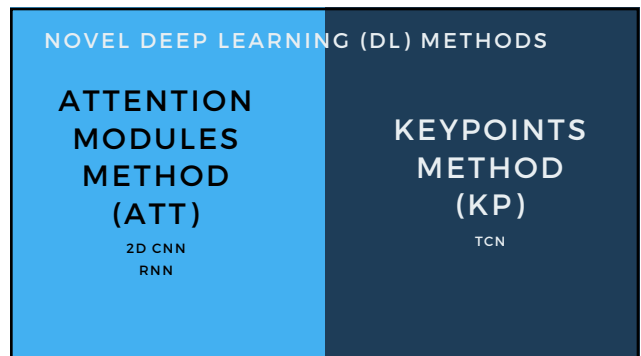
69

- COMPUTER VISION (CV) METHODS**
- 1 Bag of Words (BoW)
  - 2 Augmented Bag of Words (Aug BoW)
  - 3 Discrete Fourier Transform (DFT)/Discrete Cosine Transform (DCT)
  - 4 Sequential Motion Textures (SMT)
  - 5 Approximate Entropy (ApEn)/Cross Approximate Entropy (XApEn)

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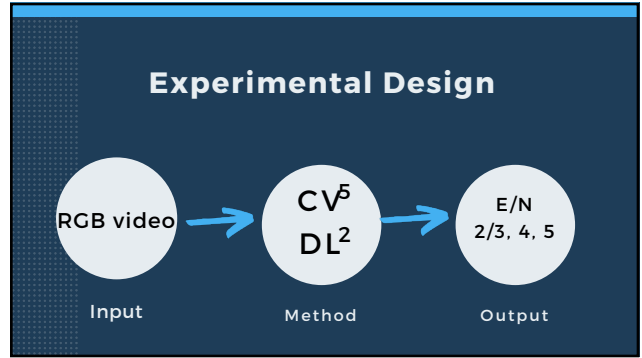
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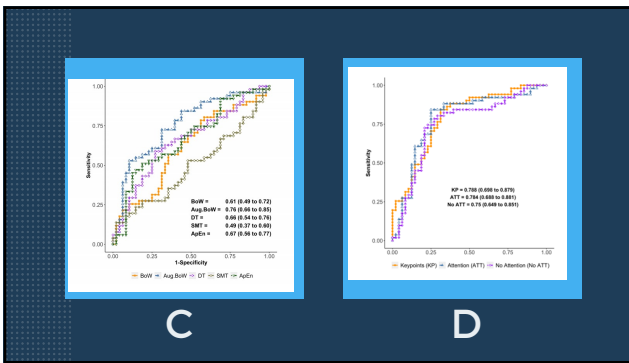
72

# Assess AI methods for objective, unbiased video-based assessment

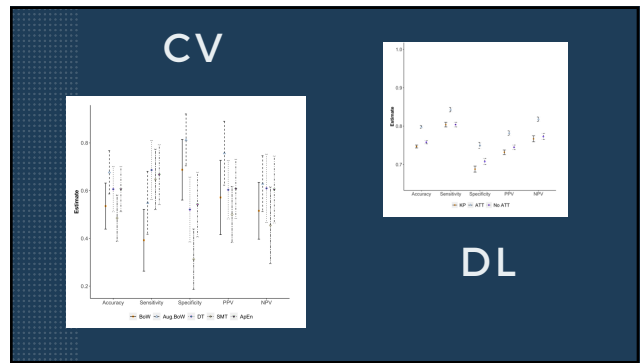
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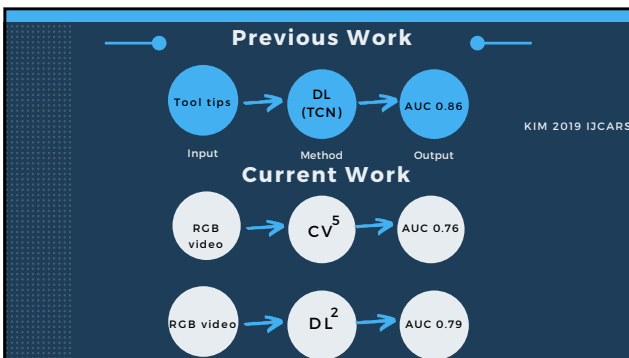
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### Current progress

- We can get a crowd to annotate instrument labels on surgical videos
- We can get a machine to identify the correct phase of surgery with the labels
- We can use machine learning to assess performance of the chapter CV < DL < DL with attention


DL methods susceptible to class differences  
Assessment directly from RGB video

78

DEEP LEARNING USING ATTENTION MODULES CAN BE USEFUL TO ASSESS INTRAOPERATIVE SKILL DIRECTLY FROM VIDEO

DEEP LEARNING > INTEREST-POINT BASED METHODS TO ASSESS INTRAOPERATIVE SKILL

EXTERNAL VALIDATION AND EVALUATION OF DEEP LEARNING METHODS FOR INTENDED PURPOSES



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## Where do we go next?

How do we get there?

Can we use AI to help?

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### SAM - The Foundational Model from Meta

CLIP: Connecting text and images

DALE 2

ChatGPT

## Segment Anything

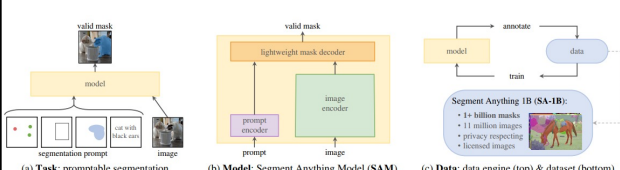
Research by Meta AI

Welcome to the Team!

Jay Paraniage

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### SAM - At a Glance



(a) Task: promptable segmentation (b) Model: Segment Anything Model (SAM) (c) Data: data engine (top) & dataset (bottom)

Figure 1: We aim to build a foundation model for segmentation by introducing three interconnected components: a promptable segmentation *task*, a segmentation *model* (SAM) that powers data annotation and enables zero-shot transfer to a range of tasks via prompt engineering, and a *data engine* for collecting SA-1B, our dataset of over 1 billion masks.

Jay Paraniage

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### Data - What is it trained on?

- 11 Million images - high resolution, from photographers worldwide
- 1 Billion Masks - generated automatically by the SAM data engine(details coming up)
- Publicly available dataset - SA-1B

Jay Paraniage

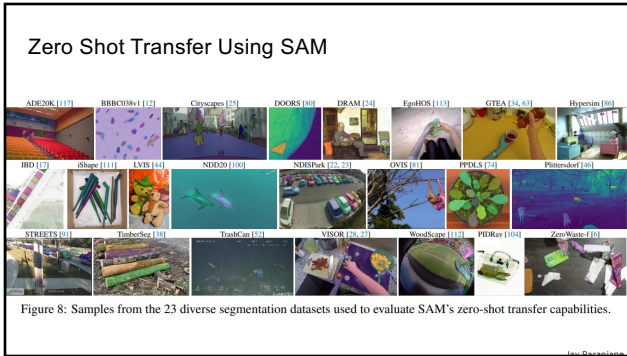
83

### Results




Jay Paraniage

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## Grounded-SAM

- Segment Anything is a strong segmentation model. But it needs prompts (like boxes/points) to generate masks.
- Grounded DINO is a strong zero-shot detector which enables to generate high quality boxes and labels with free-form text.
- The combination of the two models enables to detect and segment everything with text inputs!

Project By [IDEA-Research](#)

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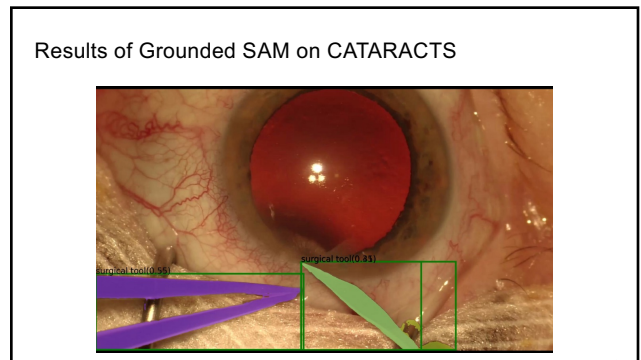
### Zero Shot Open Set Detection + Segmentation = Grounded SAM

Text Prompt: The running dog

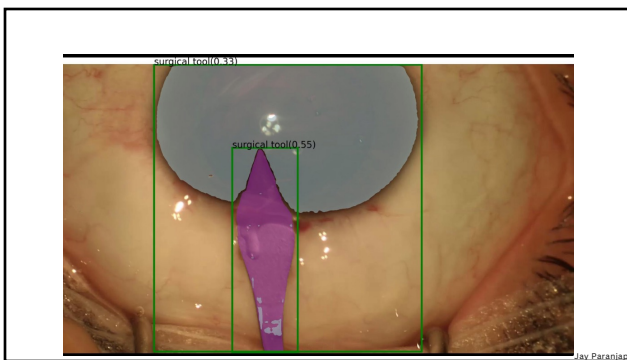
Grounded DINO

SAM

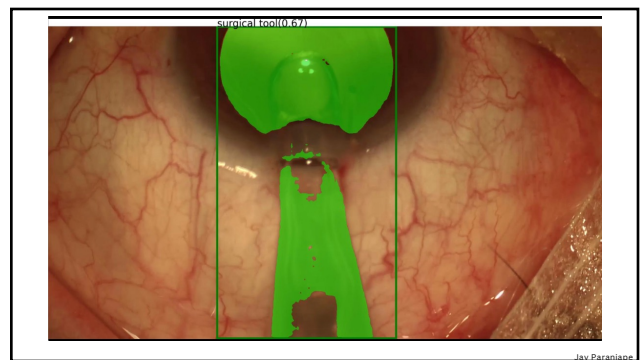
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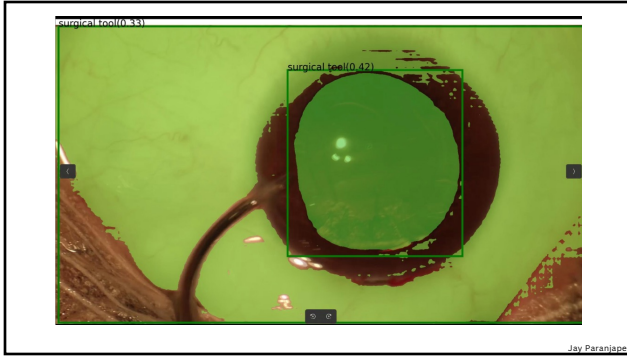
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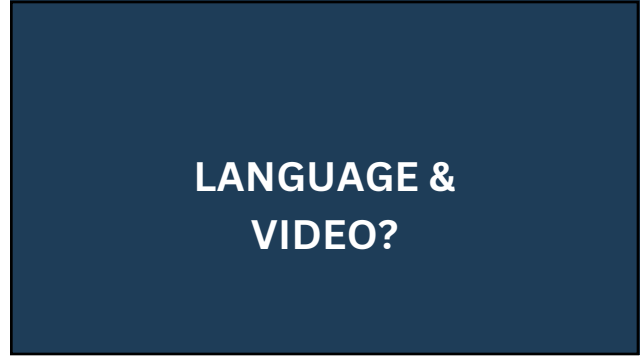
89



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**QuerYD**  
Audio + text narratives

Nisam Shah

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**Video Localized Narratives**  
Narratives are shallow but they are grounded to the video

Nisam Shah

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**LLAVA - A few Zero shot experiments**

Describe the image.

The image features a man ironing clothes while standing on the back of a yellow van. The van is parked on the street, and the man is using an ironing board attached to the vehicle to do his laundry. The scene is quite unusual, as ironing clothes while standing on a moving vehicle is not a common practice. In the background, there are a few other cars parked along the street, and a traffic light can be seen. Additionally, there is a tie located near the man, possibly indicating that he is in the process of ironing it as part of the laundry task.

Nisam Shah

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Describe the image.

The image shows a person's eye with a foreign object, possibly a hook or a metal tool, lodged in the center of the eye. The eye appears to be red and irritated, possibly from the intrusion. Several medical instruments, including scissors and a knife, are present in the scene, suggesting that a surgical procedure is being performed or about to be performed. The person's eye is the main focus of the image, while the various medical instruments are scattered around the area.

Nisam Shah

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What is happening in the cataract surgery?

In the image, a person is undergoing cataract surgery, which is a medical procedure to remove a cataract from the eye. A cataract is a cloudy lens in the eye that affects vision. The surgery involves making an incision in the eye and removing the cloudy lens, replacing it with a clear artificial lens. The foreign object, possibly a hook or a metal tool, is likely a part of the surgical equipment used during the procedure to help remove the cataract or to hold the lens in place while the incision is being made.

Was there minimal loss of viscoelastic through the main wound?

Based on the image, it is not possible to determine if there was minimal loss of viscoelastic through the main wound. Viscoelastic is a material used during surgery to maintain space in the eye and to help with the removal of the cataract. The focus of the image is on the eye and the surgical instruments, but it does not provide enough information to assess the amount of viscoelastic that has been lost.

Nisarg Shah

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Was the eye maintained in the center of the view?

Yes, the eye is the central focus of the image, and it is maintained in the center of the view. This allows for a clear representation of the cataract surgery and the medical instruments being used during the procedure.

Which stage of the surgery is currently going on?

It is difficult to determine the exact stage of the surgery from the image. However, given the presence of the foreign object (such as a hook or a metal tool) and the medical instruments like scissors and a knife, it is likely that the surgery is in the middle of the procedure or approaching the removal of the cataract. The precise stage of the surgery cannot be confidently determined from the image alone.

Nisarg Shah

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What are the factors that the surgeon should be careful about during this part of the procedure?

During this part of the cataract surgery, the surgeon should be cautious about several factors to ensure a successful and safe procedure. Some of these factors include:

1. Maintaining proper positioning: The surgeon must ensure that the eye is appropriately positioned and aligned with the surgical instruments, which can be challenging given the small and delicate nature of the eye's anatomy.
2. Managing the removal of the cataract: Carefully removing the cataract while minimizing the risk of damage to the surrounding eye structures, such as the cornea and the lens, is crucial.
3. Handling the surgical instruments: The surgeon needs to skillfully manipulate the scissors, knife, and other instruments to perform the surgery without causing any harm or discomfort to the patient.
4. Preventing complications: The surgeon must be vigilant about potential complications, such as bleeding, infection, or damage to the eye's structures. Prompt action must be taken to address any issues that arise during the procedure.
5. Ensuring proper visualization: The surgeon must maintain a clear line of sight to the eye's interior in order to perform the surgery accurately and efficiently.

By carefully considering these factors, the surgeon can successfully complete the cataract surgery while minimizing risks and ensuring the best possible outcome for the patient.

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OpenFlamingo

Could not run for cataract image

Nisarg Shah

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Mini GPT-4

The image is of a cataract surgery. What stage of the surgery is going on right now?

The image shows a cataract surgery in progress. The surgeon is using a phacoemulsification machine to remove the cataract from the patient's eye. The machine uses ultrasonic energy to break up the cataract into small pieces, which are then removed from the eye through a small incision. The surgeon is also using a viscoelastic material to help maintain the shape and position of the lens during the procedure.

The surgery is in the second stage, where the surgeon is removing the cataract from the eye. The first stage of the surgery was the preparation stage, where the patient's eye was numbed and the instruments were sterilized. The third stage of the surgery will be the insertion of the intraocular lens, which will replace the natural lens that was removed during the procedure.

Overall, the surgery appears to be going smoothly, and the surgeon is using the appropriate techniques and equipment to remove the cataract and restore the patient's vision.

Nisarg Shah

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Generic response

What should the surgeon be mindful of at this stage?

At this stage of the cataract surgery, the surgeon should be mindful of several factors to ensure a successful outcome:

1. Safety: The surgeon should take all necessary precautions to ensure the safety of the patient during the procedure. This includes monitoring the patient's vital signs, such as blood pressure and heart rate, and ensuring that they are comfortable and well-sedated.
2. Technique: The surgeon should use the appropriate technique to remove the cataract effectively and safely. This may involve using different sizes and types of phacoemulsification handpieces, as well as adjusting the ultrasonic energy and vacuum pressure to achieve the best results.
3. Instrumentation: The surgeon should use high-quality instruments and equipment to ensure that the procedure is performed efficiently and effectively. This includes using a well-functioning phacoemulsification machine, viscoelastic material, and intraocular lens implant.
4. Anatomy: The surgeon should be familiar with the anatomy of the eye and the surrounding structures to avoid any potential complications. This includes understanding the position and orientation of the lens, as well as the location of the ciliary body and other important structures.

Nisarg Shah

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Was the eye maintained in the center of the view?

It is not possible for me to determine if the eye was maintained in the center of the view in the provided image, as the image does not show the entire surgical field. However, it is important for the surgeon to maintain the eye in the center of the view during the cataract surgery to ensure that the procedure is performed accurately and effectively.

To do this, the surgeon may use various techniques, such as using a fixation light or device to help the patient focus on a specific point, or manually adjusting the position of the patient's eye during the procedure. Additionally, the surgeon should use a well-functioning microscope and other visualization aids to ensure that the entire surgical field is visible and that the procedure can be performed safely and effectively.

Nisarg Shah


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**But wait- there's  
more**

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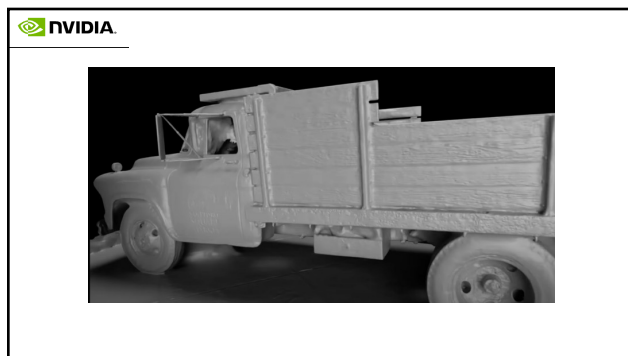
 **NVIDIA.**

Neuralangelo is an AI model for high-fidelity neural surface reconstruction.

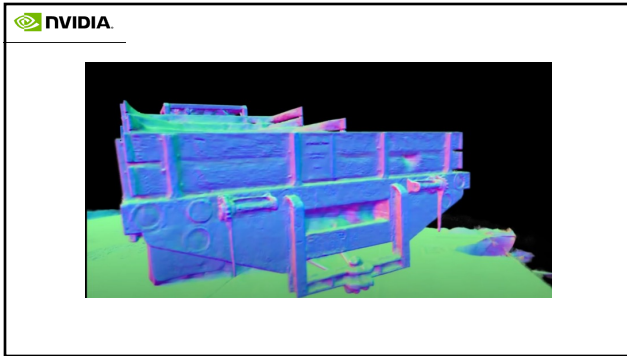
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## ISSUES WITH AI

- What's the ground truth?
- Is there bias?
- What about hallucinations?

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### External Validity

Video Quality

Surgeon Population

Institution

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### Approach for next phase

- Use data science to provide valid, objective, accessible feedback for surgeon technical skill
- Change current paradigms in
  - Resident and fellow education
  - Credentialing and licensing
  - Peer review in malpractice cases
  - Insurance reimbursements
  - Standardizing surgical clinical trials

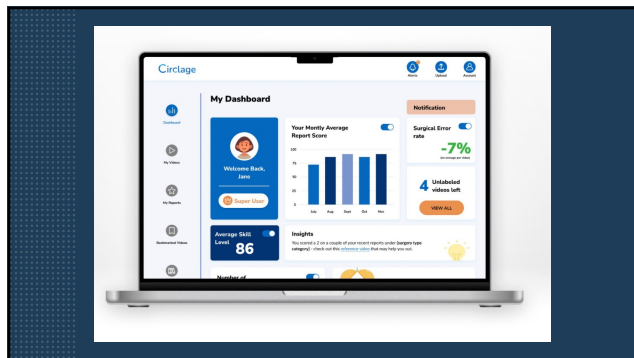
112

DEVELOPMENT IS IMPORTANT- WHAT ABOUT DEPLOYMENT?

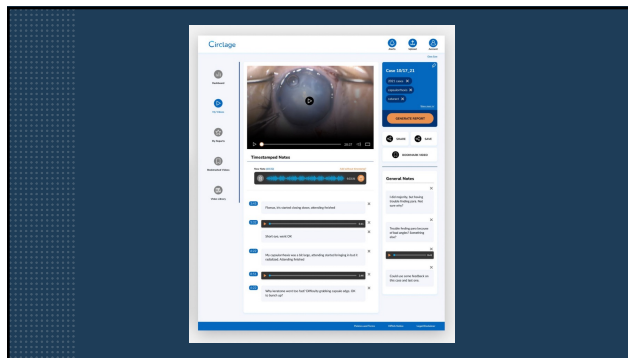
113

The image shows a stylized illustration of a doctor in a white coat pointing at a digital dashboard. The dashboard contains various charts and data points. To the right of the dashboard is the 'Circlage' logo and a 'Login' button.

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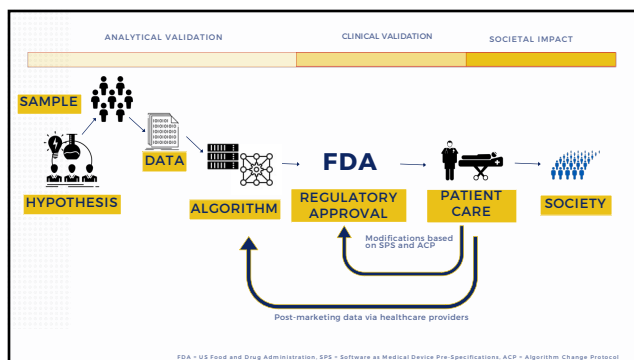
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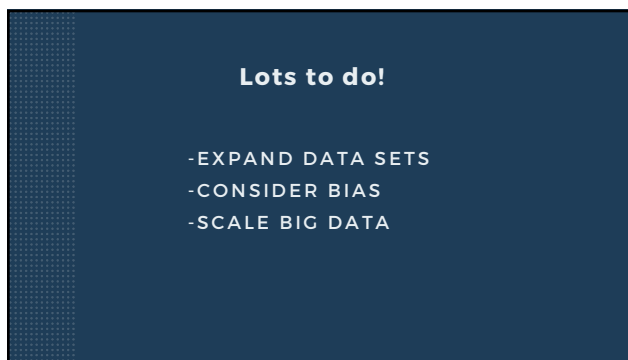
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**Questions?**  
SSIKDERI@JHMI.EDU



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 The Ophthalmologist

You look into my eye,  
You see the truth inside,  
The things I try to hide,  
The things I can't deny.

You see the pain,  
The fear, the doubt,  
The sadness and the strain,  
Of living every day,  
With this disease that's in my way.

But you don't judge me,  
You don't turn away,  
You offer me your help,  
And make me feel okay.

You tell me there is hope,  
That I can see again,  
That I can live my life,  
The way I used to do.

AI by BARD

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