Airway Mucosa Optical Imaging

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Client: Dr. Allan Brasier

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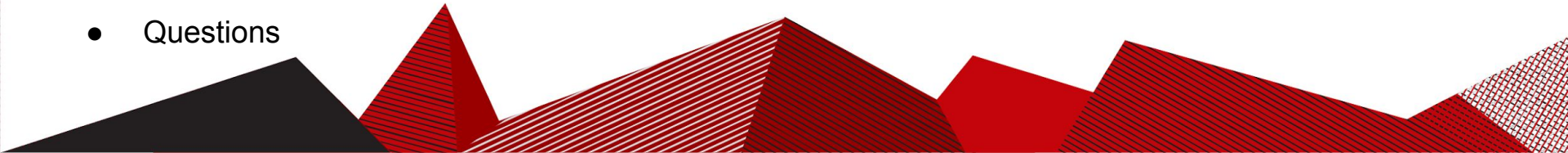


Problem Statement

- Develop an imaging probe for imaging the airway of small animals
  - Measure the changes in mucosa from airway diseases like asthma
  - Current probes are to large

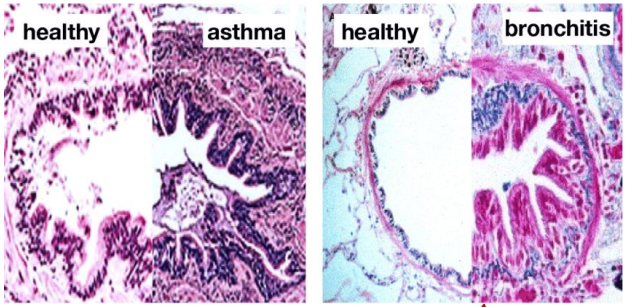


Figure 1: Difference between a healthy and diseased airway [1]

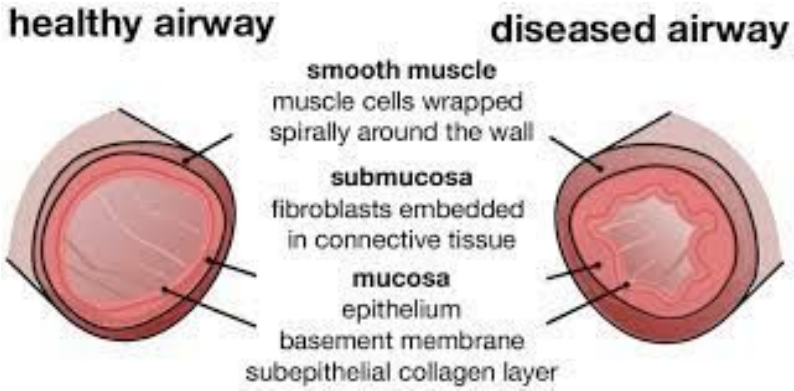


Figure 2: Difference between healthy and diseased tissue in the airway [1]

Background Research

- Current imaging options?
- Current animal probe?
- Current designs?

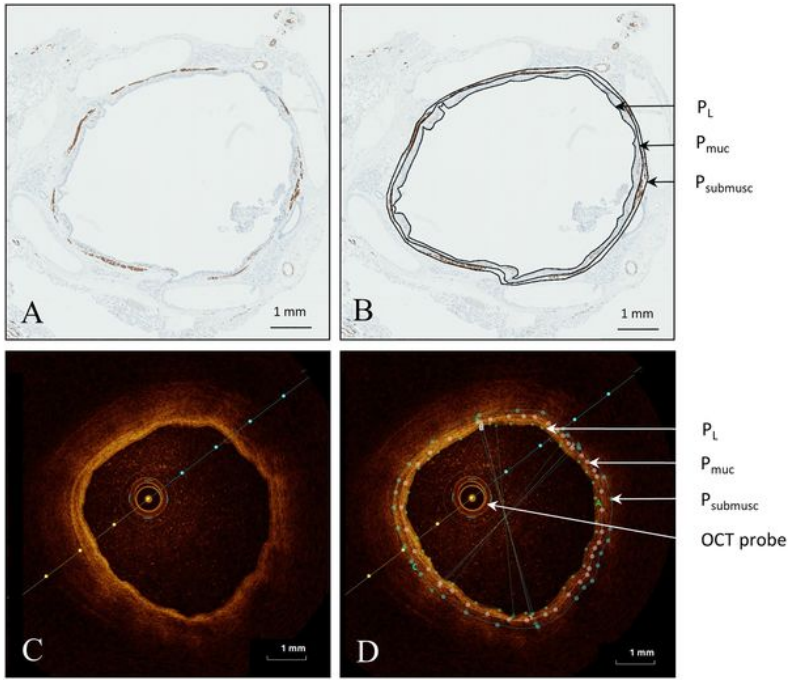
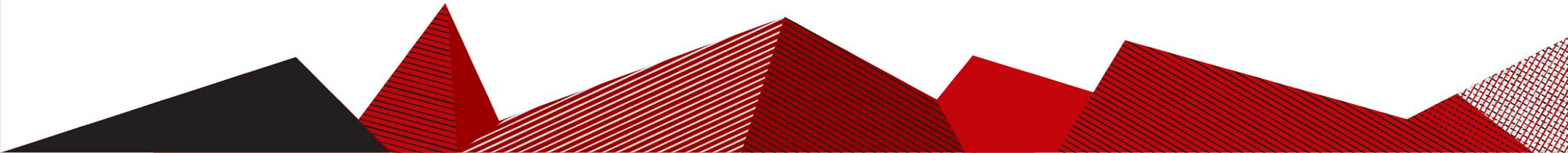


Figure 3: Histology cross section(top) and OCT cross section(bottom) [2]

Product Design Specifications

High Priority Design Requirements:

- Size
- Mouse trachea diameter 1.5mm
- Imaging depth 1 mm
- Resolution 5 - 20 um
- Reusability



Competing Designs

- OFDI on human lungs, custom-built bronchoscope
  - Airway diameter 0.8 - 1.7 mm
- Stent healing evaluation in vevo on swine
  - Terumo-OFDI catheter on a 0.014-inch guidewire

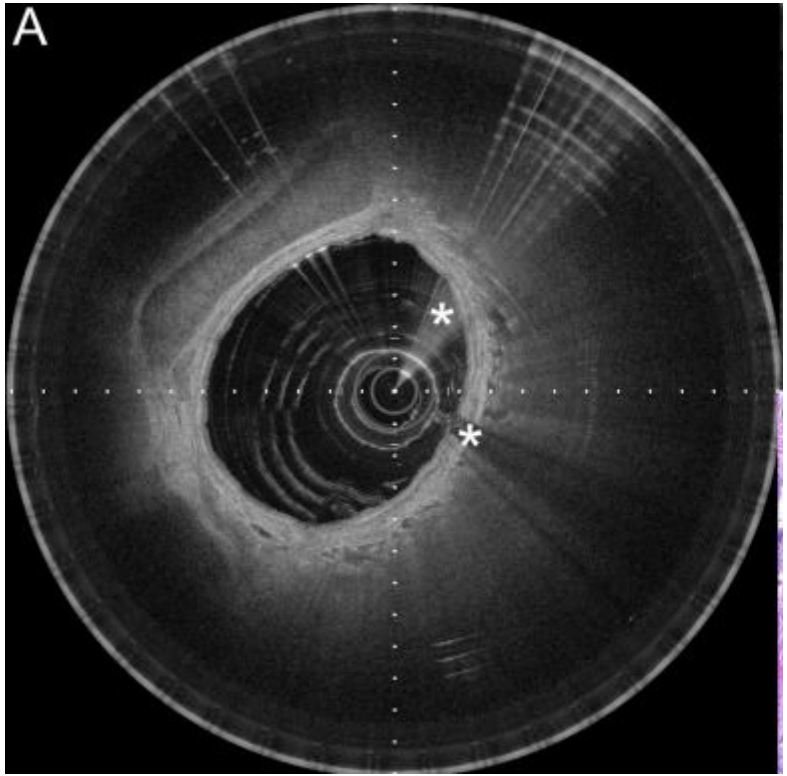


Figure 4: In vivo bronchoscopic catheter based OFDI imaging of lung airway. [3]

Competing Designs

- distal esophagus of swine
  - 4.5 cm long inflatable balloon

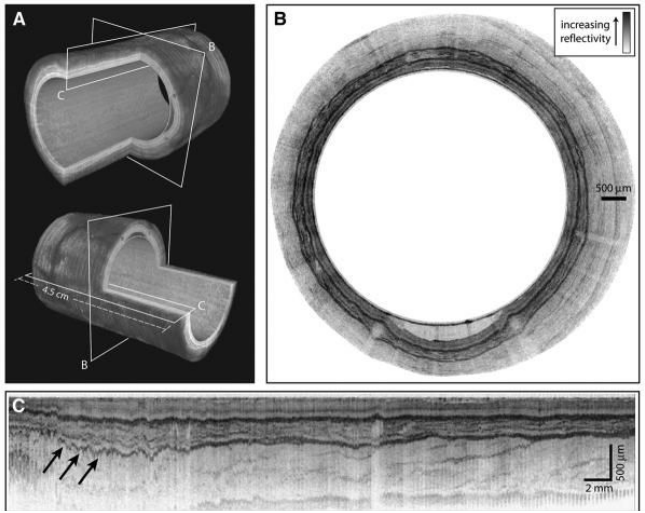


Figure 6: OFDI Imaging of distal esophagus. [4]

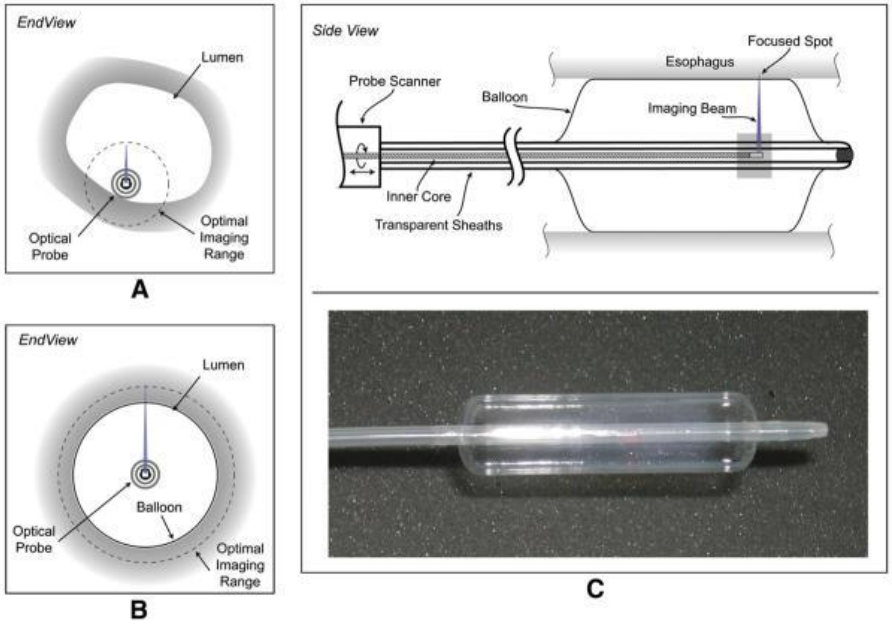
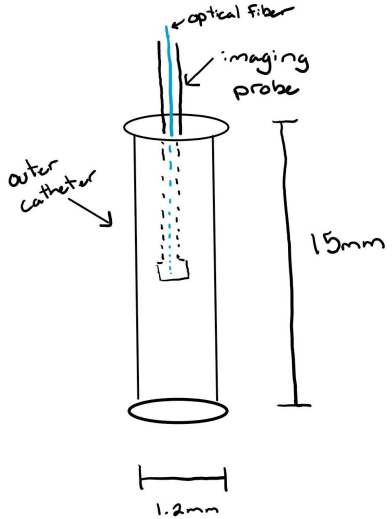


Figure 5: Catheter and stabilizing balloon mechanism. [4]

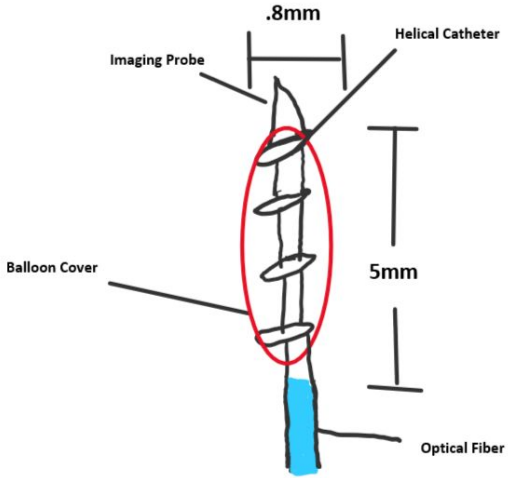
Design 1: Clear Intubation Catheter

- Catheter is inserted into mouse airway
- Includes a clear outer catheter
- Imaging probe is inside the outer catheter
- Outer catheter holds the airway in place



Design 2: Helical Balloon Catheter

- Catheter is inserted into mouse airway
- Balloon covering over helical catheter
- Imaging probe is exposed at the top
- Optical Fiber connected into helical catheter



Design 3: Flexi-Catheter Withdrawal

- Catheter is inserted into mouse airway
- Outer protective sheath can be recessed
- Imaging probe will be exposed during imaging
- Catheter is very flexible

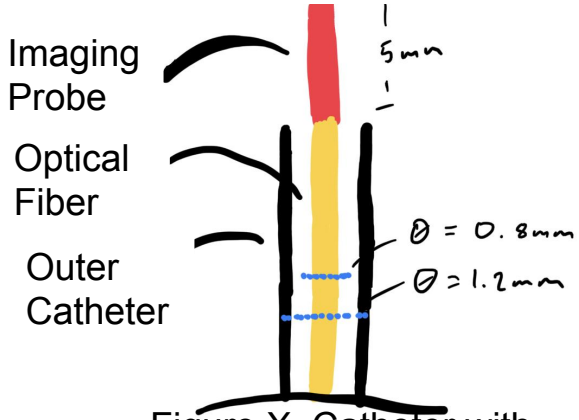


Figure X. Catheter with outer catheter resected to expose imaging probe.

Design Matrix - Probe Mechanism

Design Criteria	Clear Intubation Catheter		Helical Balloon Catheter		Flexi-Catheter Withdrawal Design	
Stability (30)	**5/5**	**30**	4/5	24	2/5	12
Manufactuability (25)	**5/5**	**25**	3/5	15	4/5	20
Accuracy (25)	3/5	15	**5/5**	**25**	**5/5**	**25**
Safety (15)	**5/5**	**15**	4/5	12	3/5	12
Cost (5)	**5/5**	**5**	4/5	4	**5/5**	**5**
Total (100)	**90**		80		74	

Design Matrix - Material

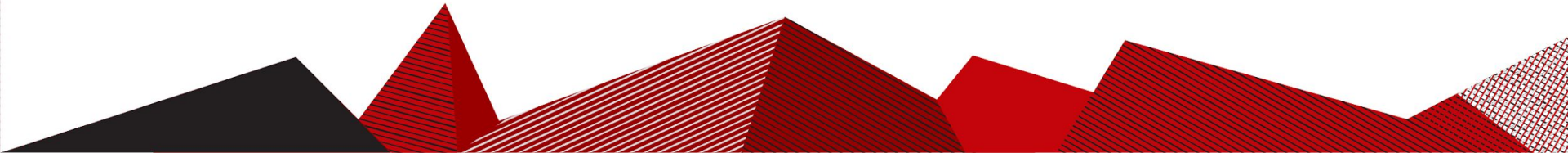
Design Criteria	Polycarbonate		Polypropylene Copolymer (PPCO)		Silicone Rubber	
Moldability & Manufacturability (30)	4/5	24	2/5	12	**5/5**	**30**
Reusability (25)	**5/5**	**25**	4/5	20	**5/5**	**25**
Safety (20)	**5/5**	**20**	**5/5**	**20**	**5/5**	**20**
Shelf Life (15)	4/5	12	**5/5**	**15**	**5/5**	**15**
Cost (10)	**5/5**	**10**	2/5	4	4/5	8
Total (100)	91		71		**98**	

Moving Forward

There are several unique challenges associated with this project.

Our team will focus our energy into developing a prototype probe that could one day be integrated into a completed imaging apparatus.

In future semesters, new BME design teams will build on our work to deliver a final product to our client, Dr. Brasier.



Acknowledgements

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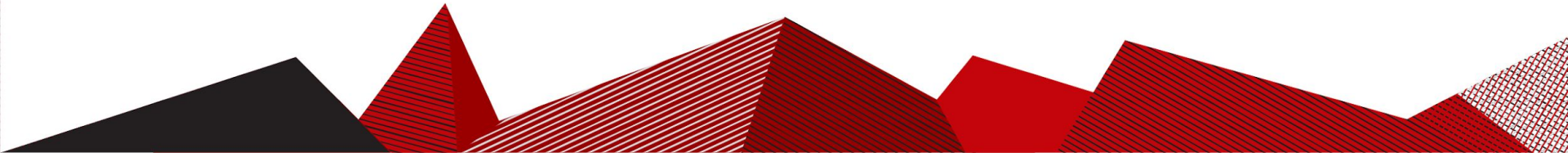

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