Automated Object Recognition & Moment of Area of Sea Lions

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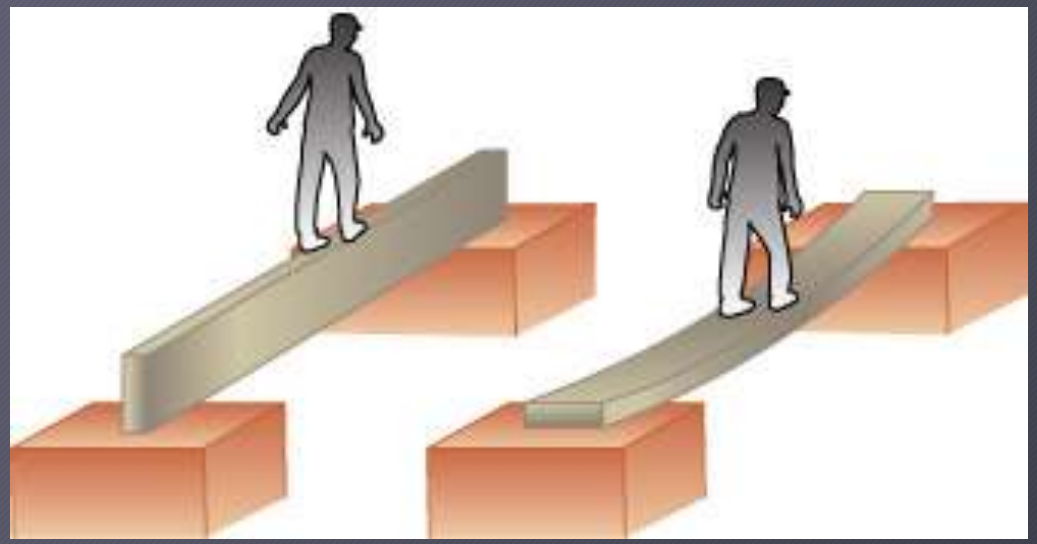
Overview

- Leftwich Lab at George Washington University in DC
- June 20th—August 12th (8 weeks)
- Create Matlab code to find moment of area of sea lions and various other projects

What is Moment of Area?

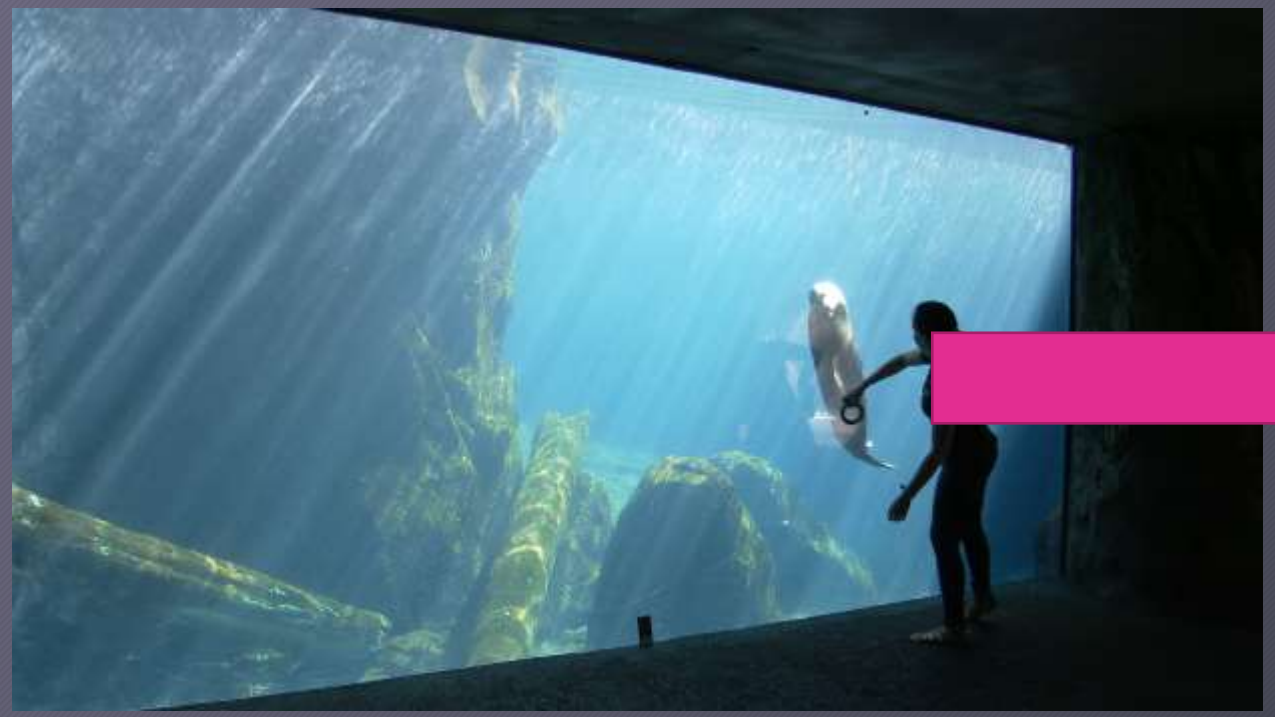
- Shape’s tendency to change
- Property that reflects how area is spread throughout a shape



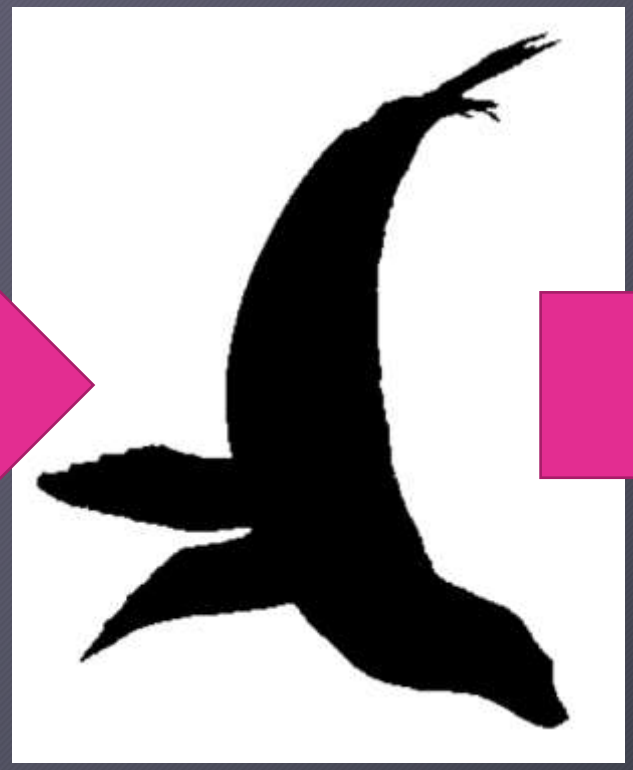
In a Sea Lion…

Finding the Moment of Area

- Image retrieving and processing



Photoshop

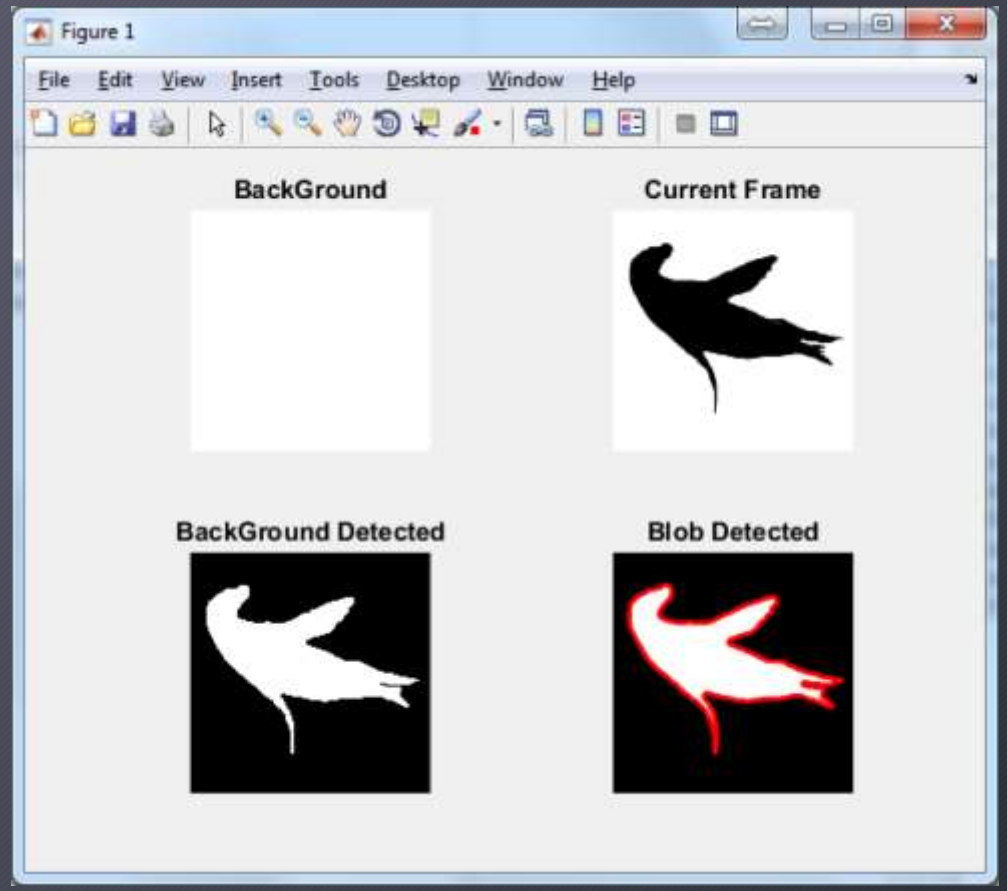


Part 1—Background Subtraction

Editor - /Users/juliehirsch/Library/Containers/com.apple.mail/Data/Library/Mail Downloads...

Moment_of_Area_mcl.m

```
1 -   clc;
2 -   close all;
3 -   clear;
4
5     %Read Background Image
6 -   Background=imread('background.png');
7     % Background=Background(1:500,1:500,:);
8
9 -   for n=1
10
11        %Read Current Frame
12 -      CurrentFrame=imread(strcat('sealion',num2str(n),'.png'));
13        %Display Background and Foreground
14
15        % %Convert RGB 2 HSV Color conversion
16 -      [Background_hsv]=round(rgb2hsv(Background));
17 -      [CurrentFrame_hsv]=round(rgb2hsv(CurrentFrame));
18 -      Out = bitxor(Background_hsv,CurrentFrame_hsv);
19        % %Convert RGB 2 GRAY
20 -      Out=rgb2gray(Out);
21        %Read Rows and Columns of the Image
22 -      [rows columns]=size(Out);
23        %Convert to Binary Image
24 -      for i=1:rows
25 -      for j=1:columns
26
27 -      if Out(i,j) >0
28
29 -      BinaryImage(i,j)=1;
30
31 -     else
```



Part 2—Boundary Detection

Editor - /Users/juliehirsch/Library/Containers/com.apple.mail/Data/Library/Mail Downloads...

Moment_of_Area_mcl.m

```
64 -        end
65
66 -        [L2 num2]=bwlabel(L);
67
68          % Trace region boundaries in a binary image.
69
70 -        [B,L,N,A] = bwboundaries(L2);
71
72          %Display results
73
74
75 -        imshow(L2);
76
77 -        imwrite(L2, 'Blob.png');
78
79 -        hold on;
80
81 -        for k=1:length(B),
82
83 -        if(~sum(A(k,:)))
84 -        boundary = B{k};
85 -        plot(boundary(:,2), boundary(:,1), 'r','LineWidth',2);
86
87 -        for l=find(A(:,k))'
88 -            boundary = B{l};
89 -            plot(boundary(:,2), boundary(:,1), 'g','LineWidth',2);
90 -        end
91
92 -        end
93
94 -        end
```

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Editor - Moment_of_Area_mcl.m

Variables - boundary

boundary

2041x2 double

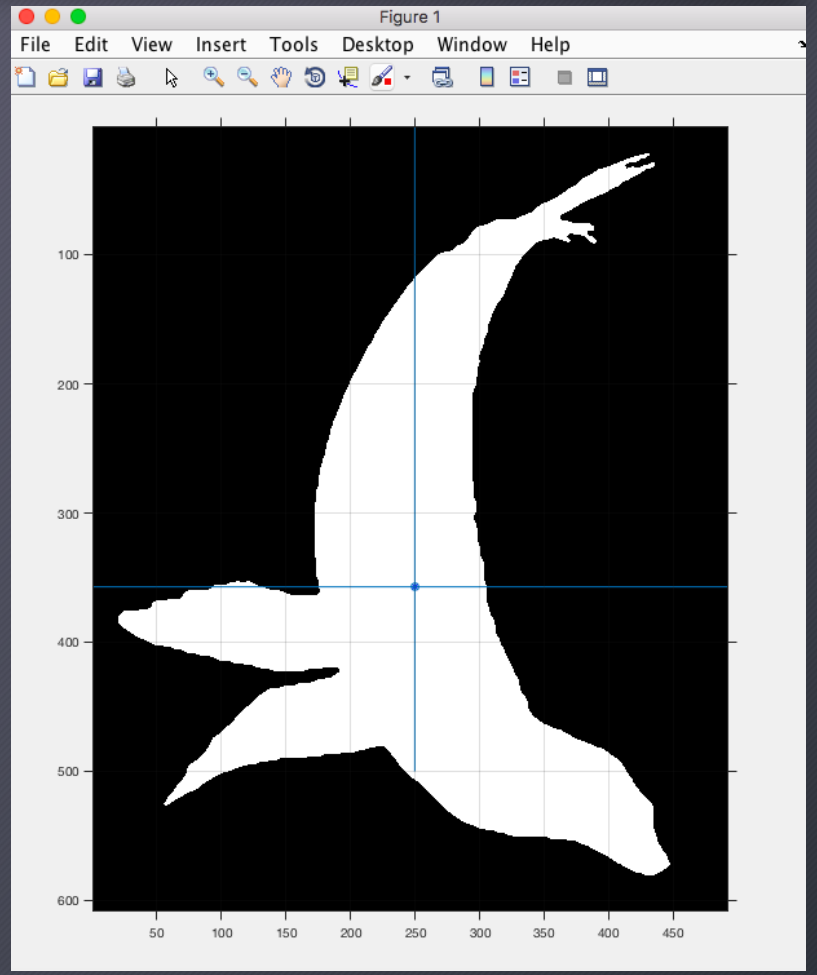
	1	2	3	4	5	6	7
1	380	21					
2	379	22					
3	378	23					
4	377	24					
5	376	25					
6	376	26					
7	376	27					
8	376	28					
9	376	29					
10	376	30					
11	376	31					
12	376	32					
13	376	33					
14	376	34					
15	376	35					
16	376	36					
17	375	37					
18	375	38					
19	375	39					
20	375	40					
21	375	41					
22	375	42					

Part 3—Centroid

Editor - /Users/juliehirsch/Library/Containers/com.apple.mail/Data/Library/M...

Moment_of_Area_mcl.m

```
94 -        end
95
96 -        BW = imread('Blob.png');
97 -        s = regionprops(BW,'centroid');
98 -        centroids = cat(1, s.Centroid);
99 -        imshow(BW);
100 -       hold on
101 -       plot(centroids(:,1),centroids(:,2), 'b*');
102
103 -       axis on;
104 -       grid on;
105
106 -       for i =1:length(s)
107 -           x_centroid(i) = s(i).Centroid(1);
108 -           y_centroid(i) = s(i).Centroid(2);
109
110 -       end
111
112 -       disp(x_centroid);
113 -       disp(y_centroid);
114
115 -       x=x_centroid(:,255);
116 -       y=y_centroid(:,255);
117
118
119 -       plot(x,y,'o');
120 -       [~, idx] = max(x);
121 -       [~,idk]=max(y);
122 -       base_point = [x(idx), y(idx)];
123
124 -       xaxisxvalues = [0 500];
```



Part 4—Calculation

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Moment_of_Area_mcl.m

```
151
152 -       clear i j a b dx dy
153 -       for i=1:500
154 -           for j=1:500
155 -               test(j)=j;
156 -               dy1(j)=(j-c_y(n))^2;
157 -           end
158 -           on=double(BW(:,i))/255;
159 -           on2=on';
160 -           dy=dy1.*on2;
161 -           dx(i)=sum(dy);
162 -       end
163 -       Ixx=sum(dx)
164
165 -        clear i j a b dx dy
166 -       for i=1:500
167 -           for j=1:500
168 -               test(j)=j;
169 -               dx1(j)=(j-c_x(n))^2;
170 -           end
171 -           on=double(BW(i,:))/255;
172 -           on2=on';
173 -           dx=dx1.*on;
174 -           dy(i)=sum(dx);
175 -       end
176 -       Iyy=sum(dy)
177
178     % % %
179     % % %       clear i j a b dx dy Ixx
180     % % %       for i=(min(B(:,2))+1):(max(B(:,2))-1)
```

Editor - /Users/juliehirsch/Library/Containers/com.apple.mail...

Moment_of_Area_mcl.m

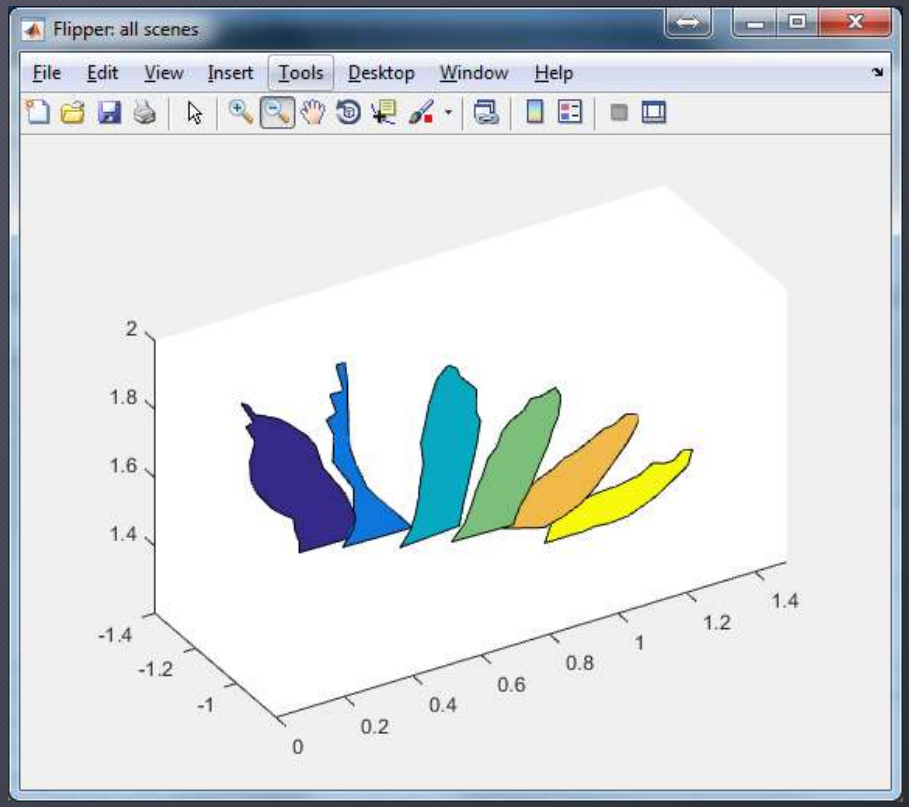
```
181     % % %           [a]=find(B(:,2)==i);
182     % % %           for j=B(a(1),1):B(a(2),1)
183     % % %               dy(j+1-B(a(1),1))=(j-c_y(n))^2;
184     % % %           end
185     % % %           dx(i+1-min(B(:,1))+1)=sum(dy);
186     % % %       end
187     % % %       Ixx=sum(dx)
188     % % %
189     % % %         clear i j a b dx dy Iyy
190     % % %       for i=(min(B(:,1))+1):(max(B(:,1))-1)
191     % % %           [a]=find(B(:,1)==i);
192     % % %           for j=B(a(1),2):B(a(2),2)
193     % % %               dx(j+1-B(a(1),2))=(j-c_x(n))^2;
194     % % %           end
195     % % %           dy(i+1-min(B(:,1))+1)=sum(dx);
196     % % %       end
197     % % %       Iyy=sum(dy)
198
199 -       J=Ixx+Iyy
200
201     %     while i<(size(boundary,1)+1)
202     %        r = sqrt((x-(boundary(i,1))).^2 + (y-(boundar
203     %        total=total+r;
204     %        i=i+1;
205     %     end
206
207 -       fprintf('The moment of area of the fish is %i',J);
208 -       J2(n)=J;
209
210
```

Future Work with Code

- Read through video frames
- Skip the Photoshop step
- More precise calculations
- Other animals

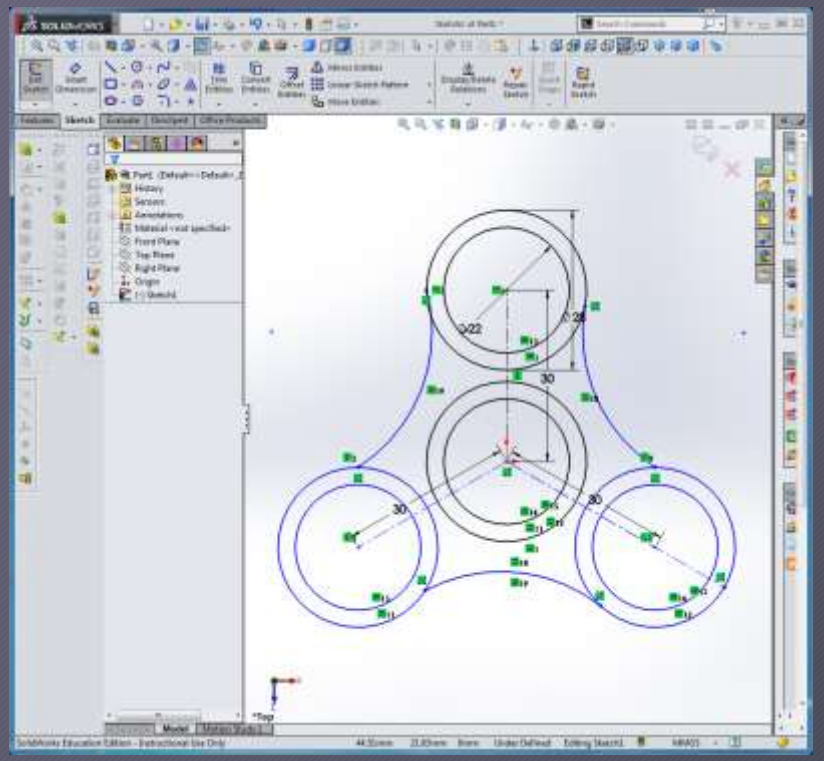
Other Projects

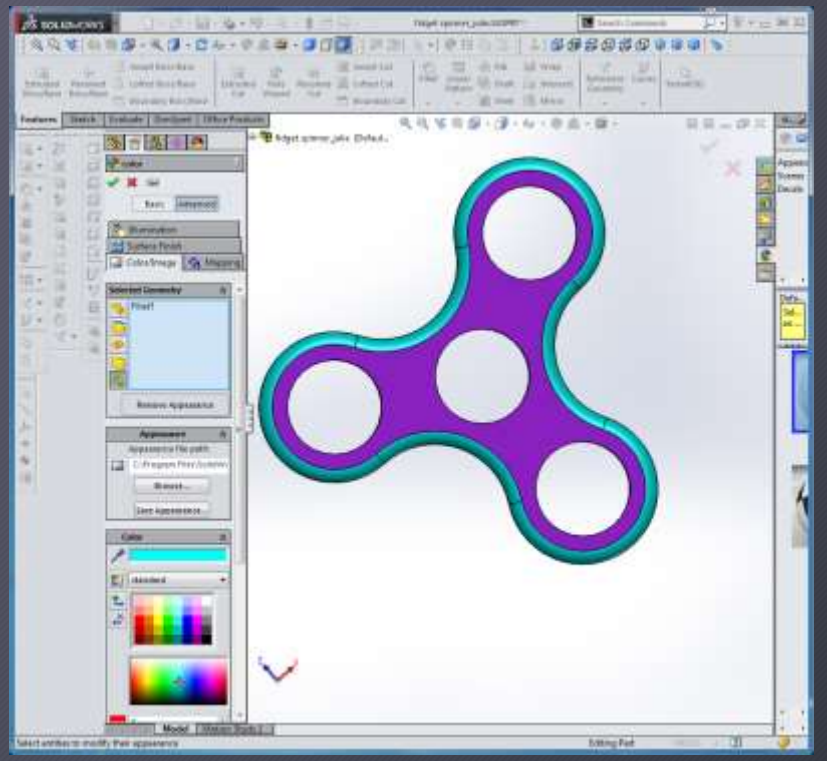
- Sea Lion tracking



Other Projects

- Fidget Spinner





What I learned

- Matlab
- SolidWorks
- Lab environment
- Questions/Help!!! (It’s ok to not know anything—I didn't)
- Work environment

Contributors

- Dr. Megan Leftwich (Professor)
- Aditya Kulkarni (Graduate Student)
- The George Washington University School of Engineering and Applied Sciences
- Mechanical and Aerospace Engineering Department
- Holton-Arms School