CEPHALOPOD CAMOUFLAGE
IMAGE COLORIZATION PROJECT

University of Chicago

Ping-Jung Liu

Adviser: Professor Rick Stevens

MOTIVATION

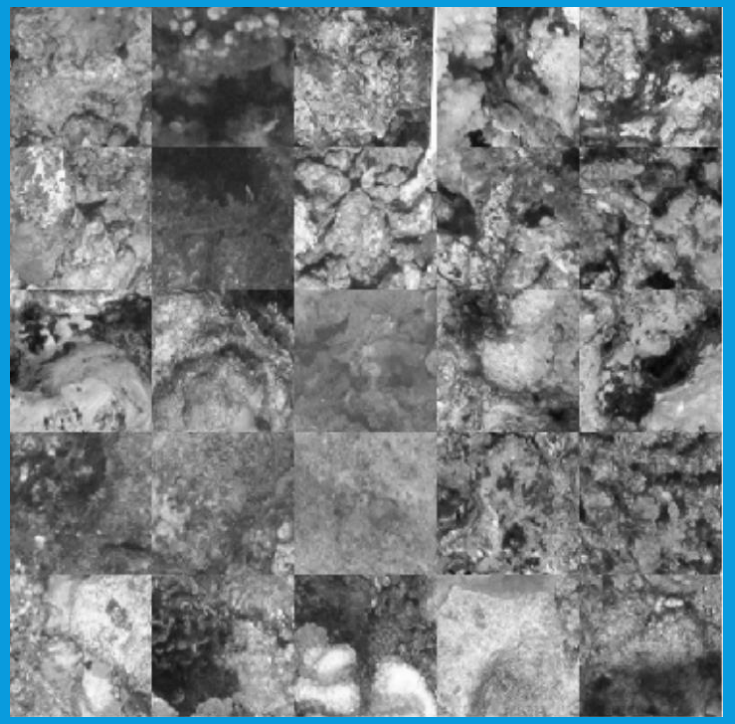
https://www.youtube.com/watch?v=1VjxvrXGEHk

MOTIVATION

- Cephalopod Paradox
  - Near perfect camouflage
  - Color blind
- Possible Explanation
  - U shaped pupils
  - Embedded colorization systems

DATASET

- 1405 underwater natural photos, 1124 used for training
- 128 X 128 X 3
- Converged to grayscale (from opencv.org) 0.299*red + 0.587*green + 0.114*blue

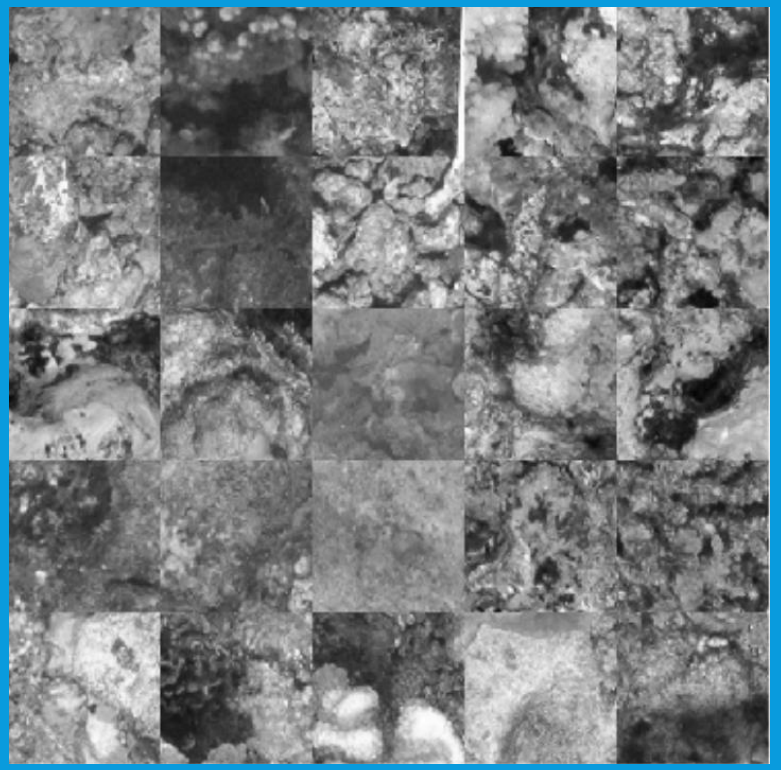


BASE CASE

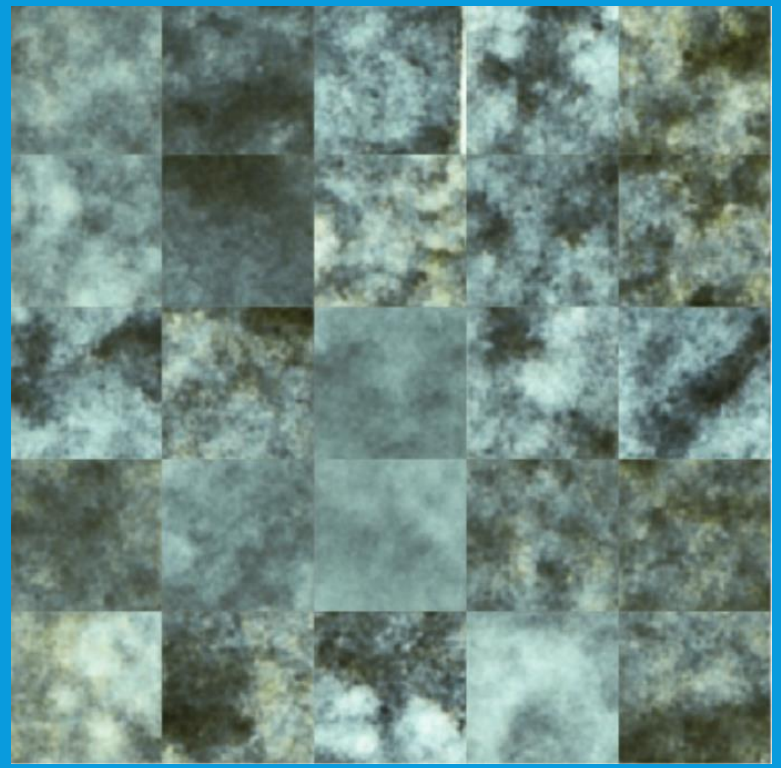
- Autoencoder
  64 => 128 => 256 => 256 => 128 => 64
- MSE + Adam
- Blurry but was able to learn color patterns

BASE CASE

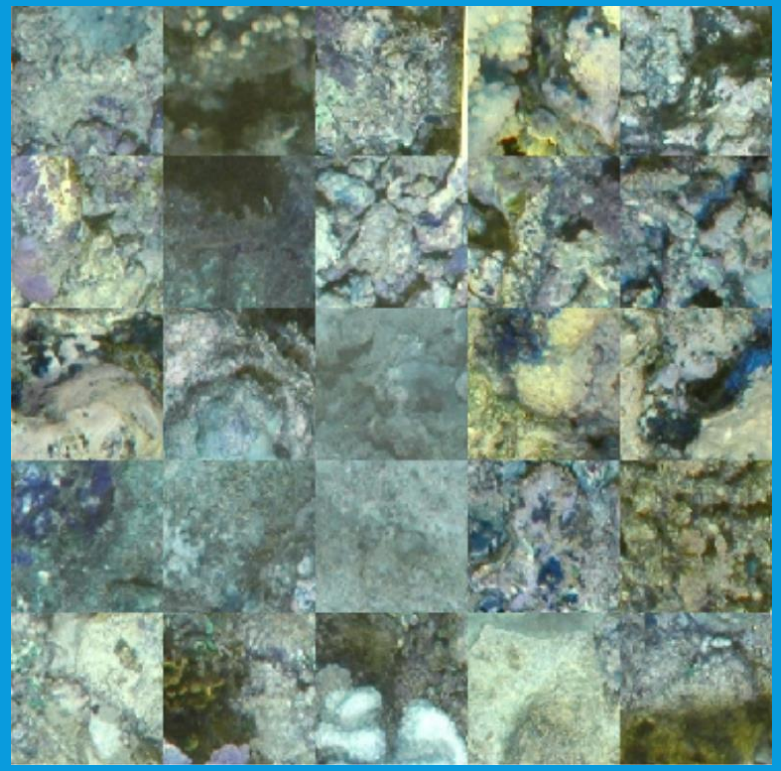
Black/White



Autoencoder



Ground Truth

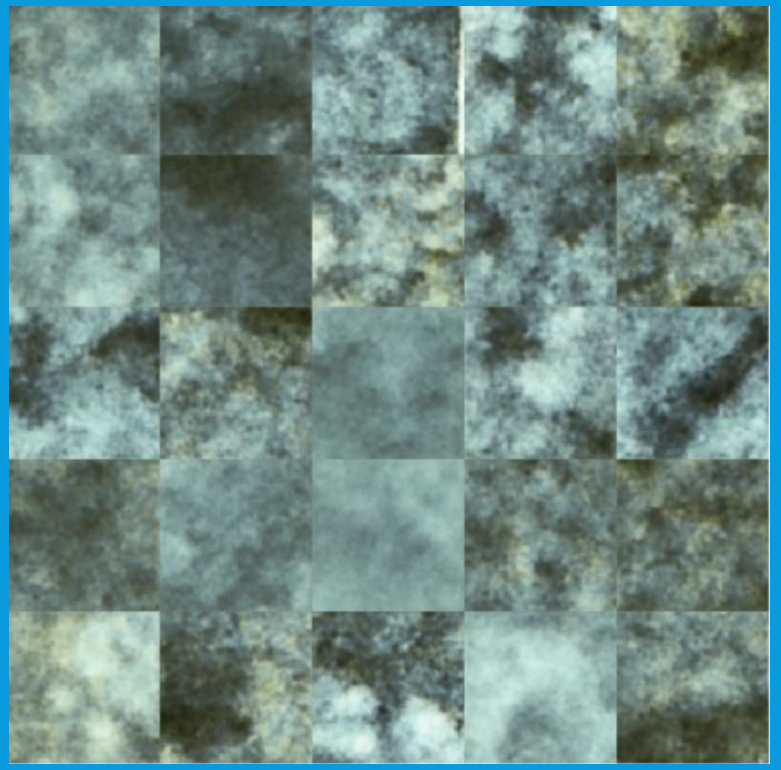


SUPER PIXEL

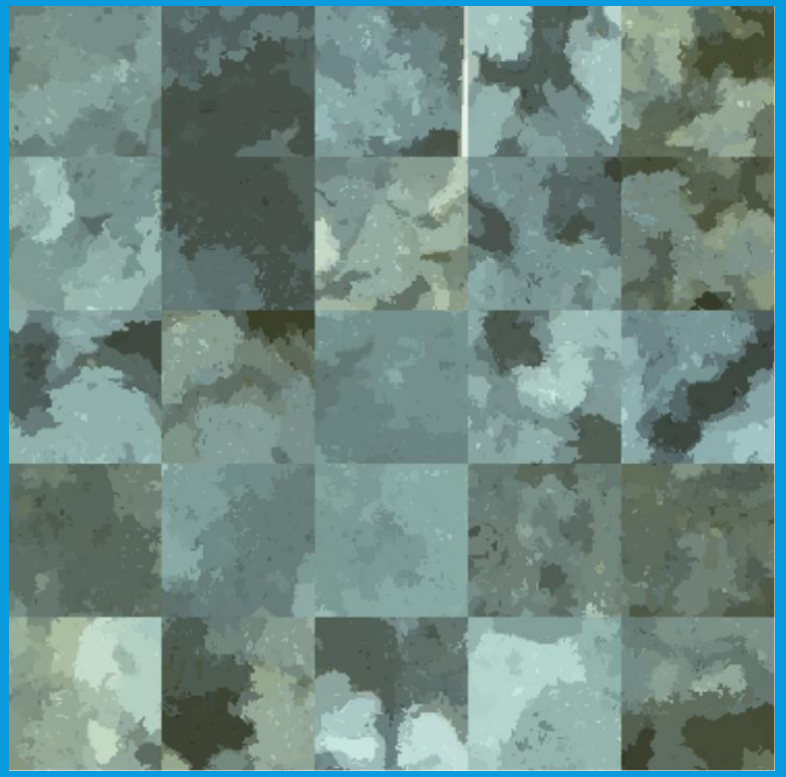
- Vague boundaries in base case
- Felzenszwalb image segmentation
- Minimum pixel per superpixel = 3
- Fill in average color for each superpixel
- Better boundaries, less texture

SUPER PIXEL

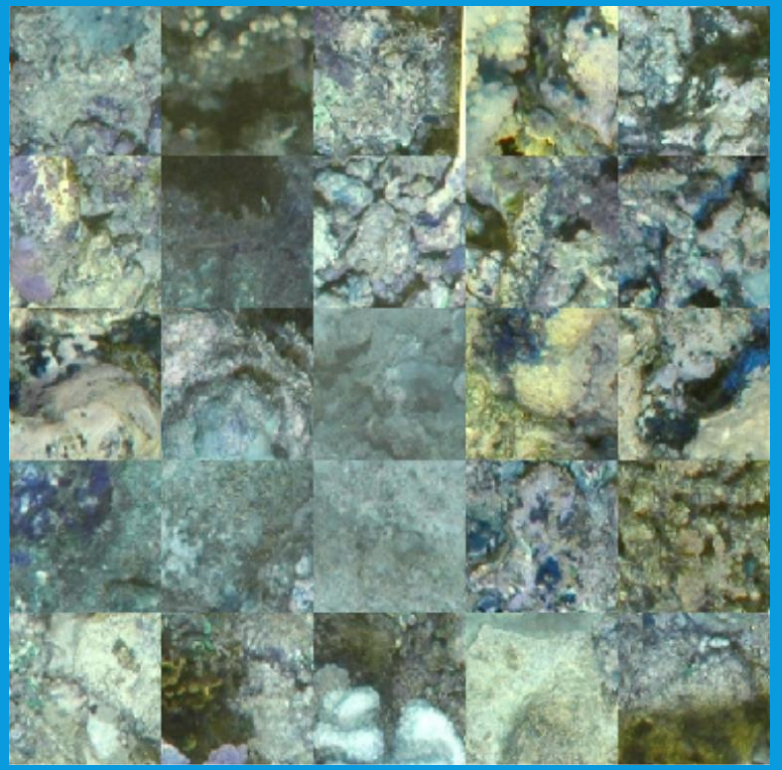
Autoencoder



Super Pixel Color



Ground Truth

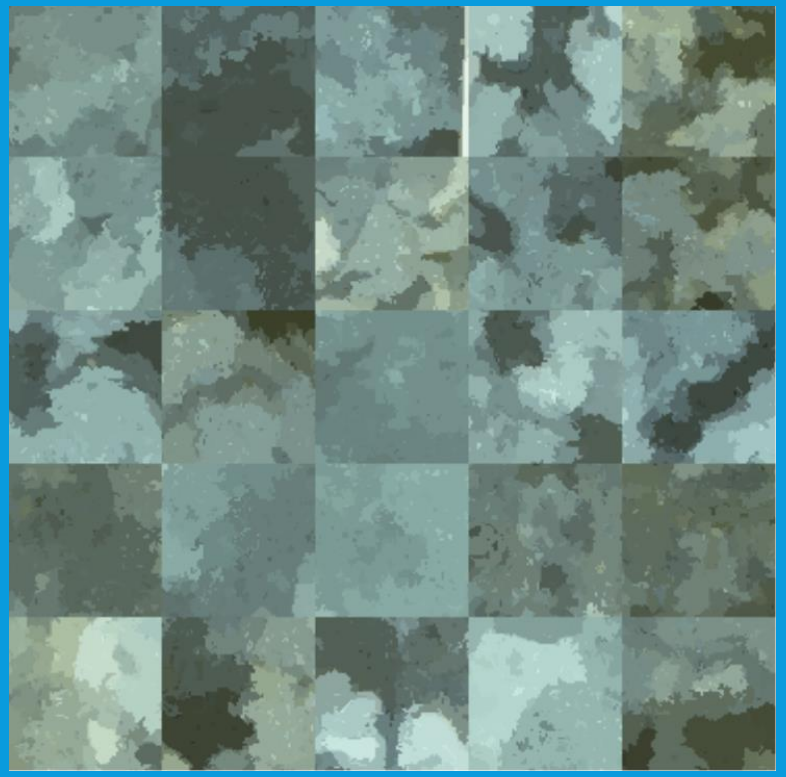


SUPER PIXEL + LUMINANCE

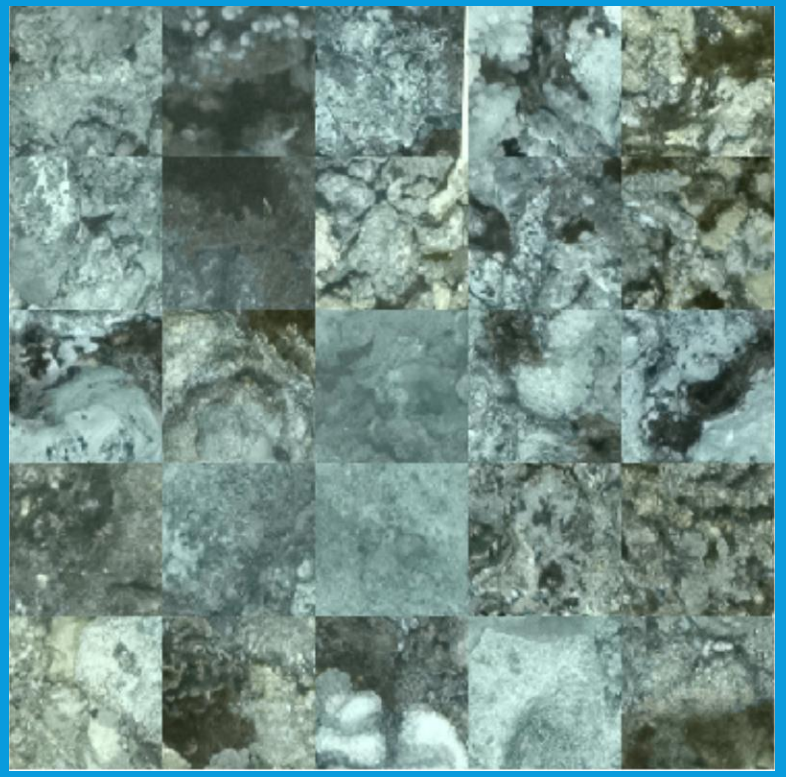
- Combine pure chromatic predictions from super pixel with luminance from base grayscale images
- For each color pixel, scale the color channels to match original grayscale values.
- Perfectly maintain texture

SUPER PIXEL + LUMINANCE

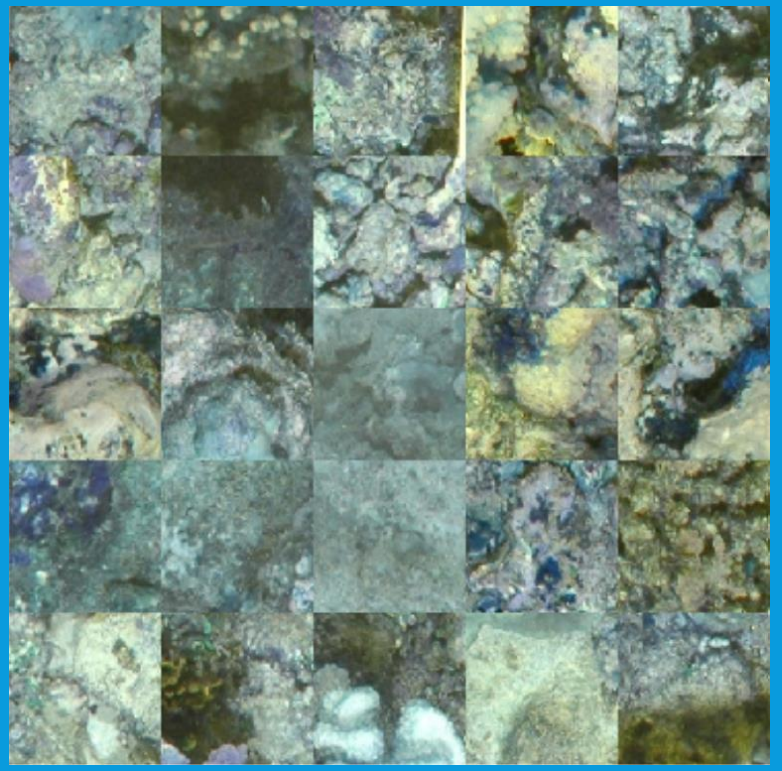
Super Pixel Color



Super Pixel + Luminance



Ground Truth



DISCUSSION + SECOND HALF QUARTER

- Possible for cephalopods to add predicted color to their black/white visions
- More hyperparameter optimization
- Better measure for difference between images
- More studies on the actual mechanisms of cephalopods' eyes and pupils

Q/A