Assignment 1: Camera Obscura

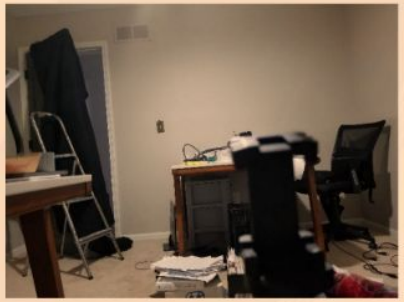
The goal of this project was to build my own camera obscura using my room as the camera!

The scene that I took and the different pinhole sizes and also how I set up my room into a camera is described on the right!

2. Discuss the scene – Where is this scene located? What subject(s) in the scene were you trying to capture?

This is my next door neighbor's house seen through the window in my office room. I was trying to capture the different big window pane, the small prism window array, the pointy roof, celing cell lighting windows, bushes around, and the sky including clouds.

- Camera obscura setup – Show the overall room setup with covered window(s) (or box obscura setup). Also, show where your camera is set up in relation to the screen to capture the final image.
- Screen setup
- Pinhole(s) setup



To completely cover door, used black blanket to wrap the door and closed tight. The white wall is the projection wall. Tripod is set up so that camera installed would face at the white wall.

I've prepared three different pinholes. 1/8 inch, 3/8 inch, and quarter coin size hole (noted "Q") was prepared. I've used electrical tapes and aluminum foil. They were made so that easy detach/attach can be done.

The window was covered using cardboard, aluminum foils, and black electrical tape to cover any light (tested with room light turned off). On the very right, you can see the tripod location (where camera will be) located under the window sitting on a piano chair.

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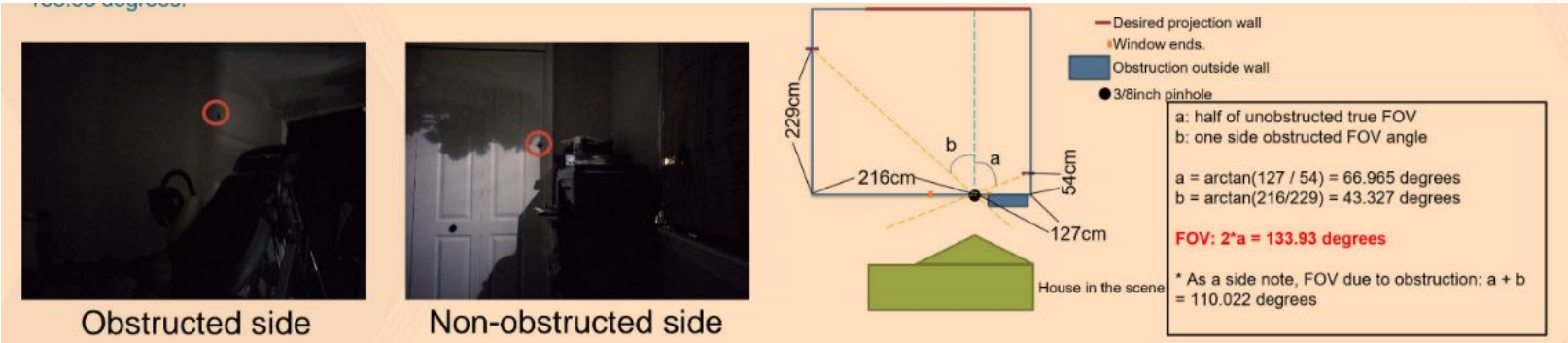
Assignment 1: Camera Obscura

This is my final result, after picking the best pinhole sizes and doing some post processing (smoothing/sharpening/color balancing, etc.). As you can see, my room has turned into a decent camera!
But to be frank, other than understanding the technology, real life application of this would be limited. However, perhaps I could in the future I could make a room that can let in beautiful scenery onto one of my walls, instead of buying expensive pictures and stuff!

Use of different pinhole sizes that show different brightness/contrast!



My very scientific way of figuring out the effective field of view angle for my room camera!

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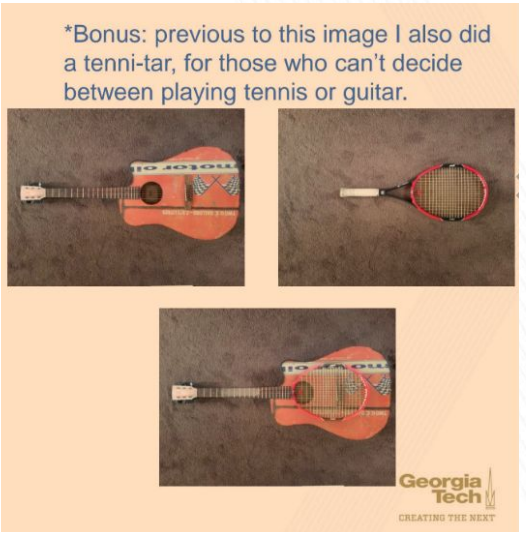
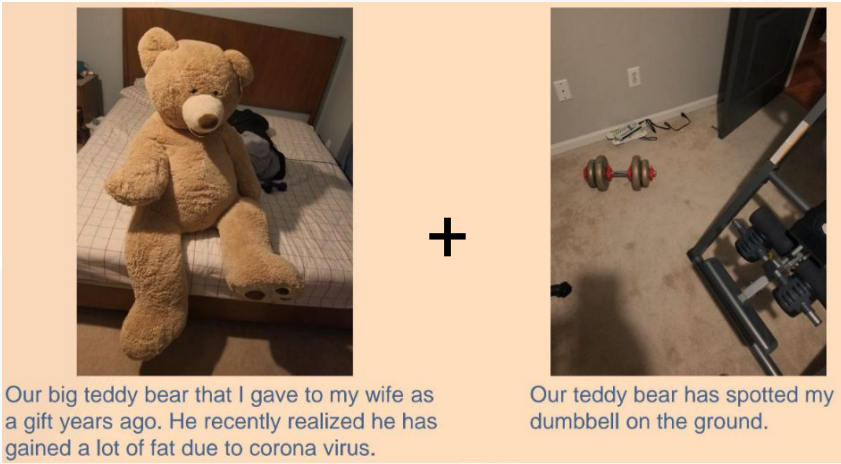
Assignment 2: Pyramid Blending

In this project, laplacian and gaussian pyramids (image-way of extracting low and high frequency components and mixing them at each frequency level to make more seamless blending between two images (one defined with a mask).
It created a smooth blend! although some artifacts can be seen if you look really closely. And obviously these things can't be real =D



bonus: my TenniTar!



+ + =

My teddy bear trying to bulk up.
Casually doing armcurls on his bed.

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Assignment 3: Panoramas

This assignment was about making panorama images as they are made in our cell phone cameras for example!. Using feature matching as below:

Many of these keypoints on tree leaves, were moving due to windy weather. Window area for each keypoint location can be analyzed for its statistics on green color distribution for example to filter out these keypoints for more robust matches.

To turn these 3 images

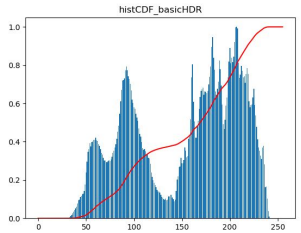
Into this:

And its cropped version! Looks good!:

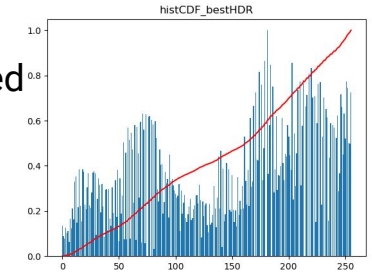
Assignment 4: HDR

This assignment was about implementing HDR techniques myself to use multiple images of the same scene taken at different exposure rates to turn into one beautiful high dynamic range (combines information from different range of contrast/brightness to show maximal information!)

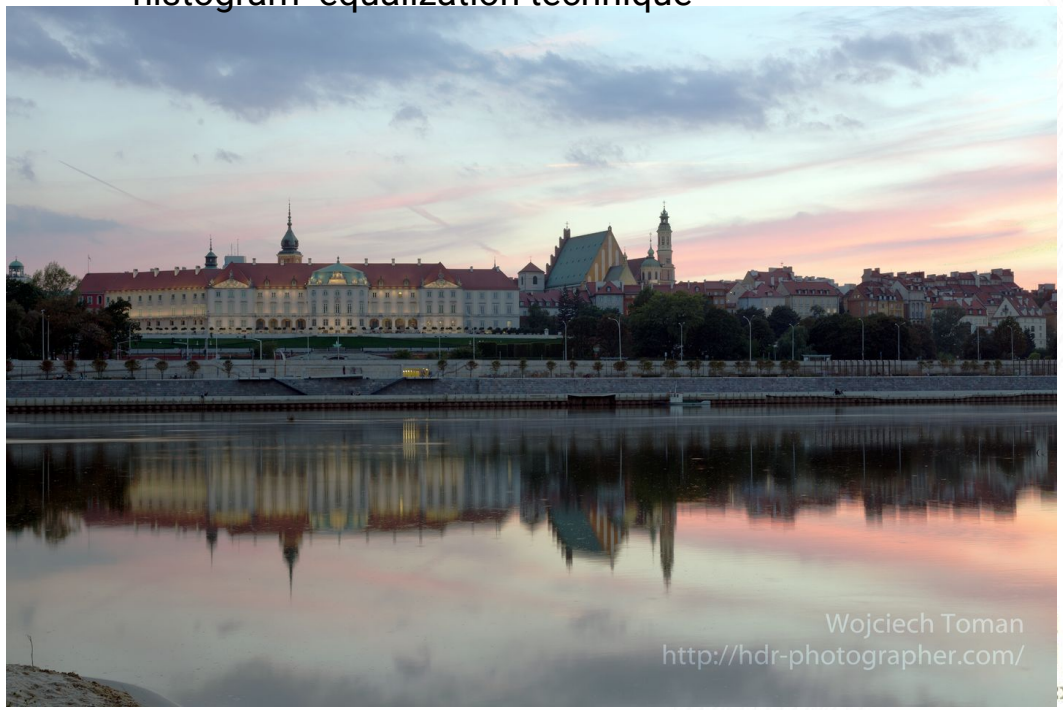
basic HDR and its pixel value usage (0~255) histogram!



Notice how more pixel values are used (spread out!) and the result is more visually vibrant scene!

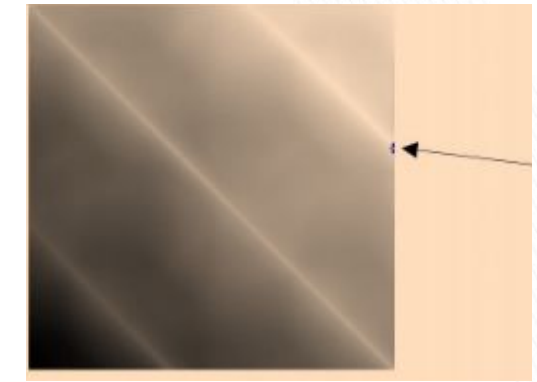


Final advanced HDR using weighted thresholded histogram equalization technique



Assignment 5: Video Textures

This assignment is about making infinitely looping video/gif from a video that has been taking which has some type of repetitions (well any animated object whose position is stationary likely has some sort of repeated motion if you take a long video!). In my case, it was actually a pretty obvious repetition from a music box, but the algorithm finds the most smooth films to make the loop at using crazy math (see right, basically root mean squared match) and figuring out which frame pairs to make the loop at!



sample 3 frames from the video!

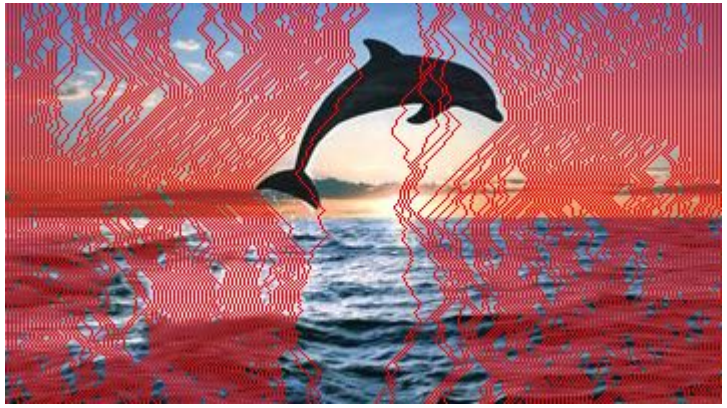
The the resulting GIF can be found here!:
https://drive.google.com/file/d/1oOg5O6nCGtZotkXsJe-VopjKiUAd_PE3/view?usp=sharing

Cute music box that I bought when I visited Sapporo region in Japan! The tape music box will turn forever!

Midterm Project

This project was about content-aware resizing of an image which reduces/enlarges images with most important content not bothered as much as possible!. Least energy-seams are found and removed or added sequentially! the result is pretty astonishingly good! The methods followed this paper: Shai Avidan and Ariel Shamir. Seam carving for content-aware image resizing. ACM Trans. Graph., 26(3):10, 2007.

reduced. Looks good! way better than just scaling horizontally



insertion seams found

enlarged! looks realistic!

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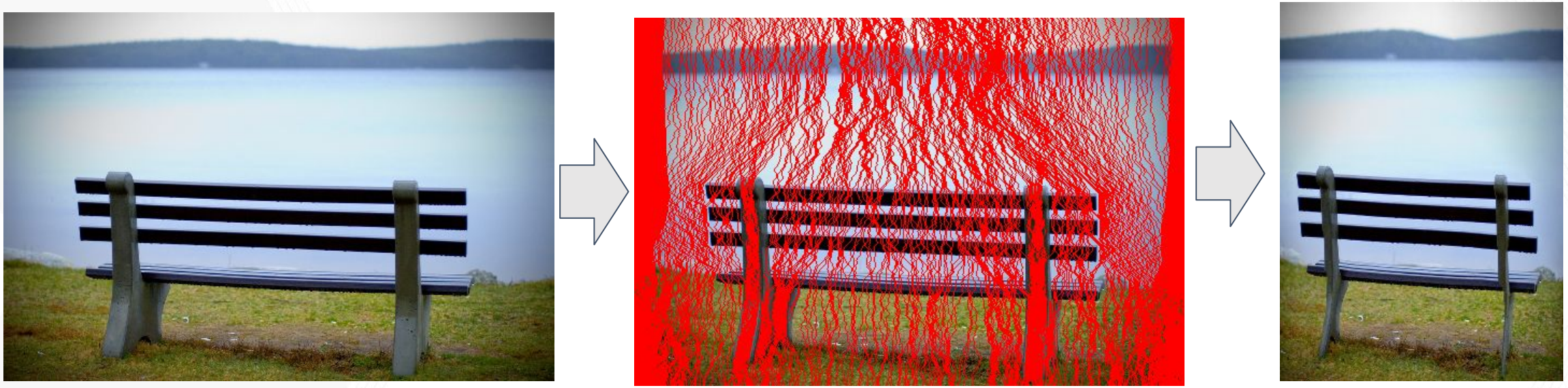
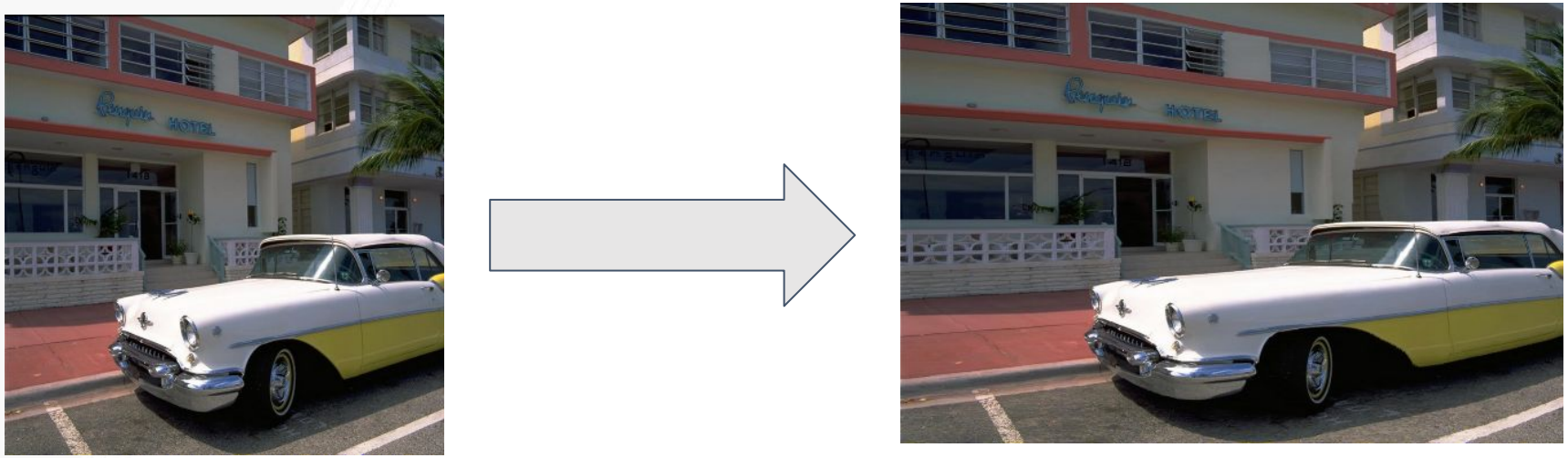
Midterm Project

More results!

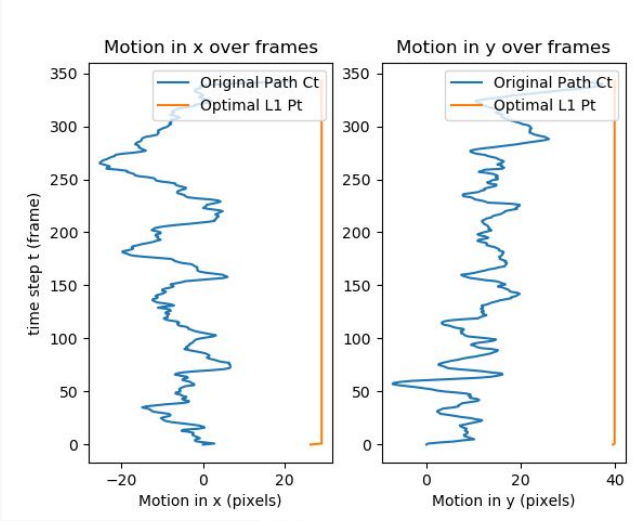




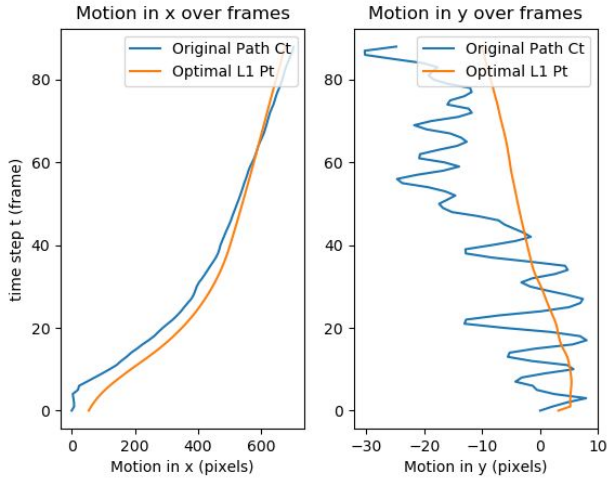
Final Project

This project was about implementing part of what exists on YouTube video stabilization algorithm! (paper: Grundmann, M., Kwatra, V., & Essa, I. (2011). Auto-directed video stabilization with robust L1 optimal camera paths. CVPR 2011, 225-232)
It's amazing how with use of matched features and linear programming optimization of carefully chosen objectives and constraints, amazing video stabilization result can happen! This one really should be watched with videos and the link is here: https://drive.google.com/drive/folders/1eoNZN0F-XaQmgPwUXYuvObfz7VXpKhSq?usp=sharing

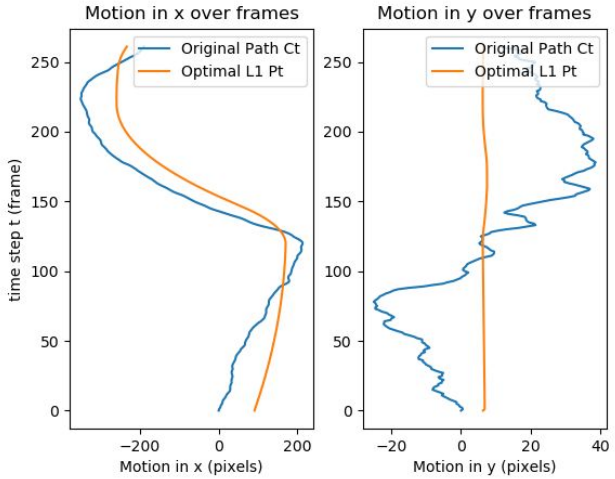
For related graphs look below! Look how shaky x and y motions of original camera path is automatically smoothed into constant, linear, and parabolic smooth motions! The algorithm can automatically find the appropriate transformations to each frame so that from frame to frame, the transition is as smooth as possible!



For result 1, where stationary-yet shaky camera path is optimized to just a constant path (by moving around crop windows!)



For result 2, very shaky camera scene taken in a car in motion! it's moving in x direction while lots of shaking in y direction -> smoothed!



For result 3, same scene as result 1 but panning motion! (as you can see in large motion in x). See the smoothed optimized path!

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Anything else?

It's been a busy semester! I hope you enjoyed my work that I presented here! More interesting works in the future coming!

- Brian Lee