Image Mosaicing Using Fourier Shift Theorem

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Abstract

Image mosaicing is a process that stitches multiple, overlapping snapshot images of a scene together in order to produce one large, high resolution composite. Thus, normal camera can be used to create a larger field of view. In this project we will implement an algorithm which is based upon Fourier Shift Theorem. This algorithm uses the fact that shifting a signal in the spatial domain causes change in the phase of the Fourier Transform.

$$f(x - x_0, y - y_0) \xrightarrow{DFT} F(u, v)exp\frac{-j2\pi(ux_0 + vy_0)}{N}$$

where

$$f(x, y) \xrightarrow{DFT} F(u, v)$$

In this project, we will take two images as input, which would be the image of a scene captured through a normal camera such that both of the image have atleast 50% part in common. The two images would be misaligned i.e. the images may be translated and rotated versions of each other. We will find the translation vector and the angle θ between the images using Phase only correlation (POC). The POC function

$$\hat{r}_{fg}(x, y) = IDFT(\frac{F(u, v)\overline{G(u, v)}}{|F(u, v)\overline{G(u, v)}|})$$

Let, f_θ is the rotated version of image f. We can find the rotation angle

$$\Theta = \underset{\theta}{\text{argmax}}(max(\hat{r}_{f_\theta g}(x, y)))$$

and image displacement (x_0,y_0) can be find out from the peak location of

$$\hat{r}_{f_\Theta g}(x, y)$$
