

## Project 5 Questions

### Instructions

- 4 questions.
- Write code where appropriate.
- Feel free to include images or equations.
- **Please use only the space provided and keep the page breaks.** Please do not make new pages, nor remove pages. The document is a template to help grading.
- If you really need extra space, please use new pages at the end of the document and refer us to it in your answers.

### Questions

**Q1:** Suppose you have a sequence of  $N$  images, and you have computed the  $N - 1$  homographies between each image pair. Let  $I_p \neq I_r$  be two images in the set. Thus, homography  $H_{rp}$  transforms image  $I_p$  to  $I_r = H_{rp}I_p$ . How can we relate the transformation from image  $I_p$  to image  $I_r$  assuming we have image  $I_q$  between them. What should we do if we need to transform image  $I_r$  to  $I_p$  using only the  $N - 1$  homographies computed?

**A1:** *How can we relate the transformation from image  $I_p$  to image  $I_r$  assuming we have image  $I_q$  between them:*

(1):  $I_p$  to  $I_q = H_{qp}I_p$  and

(2):  $I_q$  to  $I_r = H_{rq}I_q$  then

(1) e (2):  $I_r H_{rq}^{-1} = H_{qp}I_p$  then  $I_p$  to  $I_r = H_{qp}I_p H_{rq}$

*What should we do if we need to transform image  $I_r$  to  $I_p$  using only the  $N - 1$  homographies computed?*

We should compute the inverse of homography  $H_{rp}$ . Thus we can transform image  $I_r$  to  $I_p$ :

(1):  $I_p$  to  $I_r = H_{rp}I_p$  then  $I_r$  to  $I_p = H_{rp}^{-1}I_r$

**Q2:** Using the RANSAC method to fit data to a model is particularly interesting when the data is considerably noisy. Why using RANSAC in project 5 is interesting? Why the number of outliers tend to grow as you add new images to the mosaic?

**A2:** O RANSAC consegue estimar de forma robusta os parâmetros do modelo. Ou seja, considerando um conjunto de dados com ruído (*noisy*, com grande número de *outliers*), é possível obter um bom resultado com alta precisão (incluindo várias iterações e escolha de um *threshold* que faça sentido ao problema).

A quantidade de *outliers* aumenta pois o conjunto de pontos distintos no *mosaic* é maior, dificultando a precisão do algoritmo.

**Q3:** Suppose you are implementing a mosaicing application. Once defined the image that will be the mosaic plane, at the mosaic center, how can we transform the remaining images in only one step, i.e, what we must change in each homography matrix to account for the relative translation?

**A3:** Com o objetivo de projetar as imagens com relação ao *mosaic plane*, é necessário relacionar o sistema de coordenadas do *mosaic plane* com as homografias calculadas. Portanto, a multiplicação das homografias das imagens intermediárias (tal como no exercício Q1) entre os pares de imagens definida pelo *mosaic plane* e por cada uma das imagens restantes é necessária.

**Q4:** If we know the homography matrix  $H_{rp}$  that transforms image  $I_p$  to  $I_r$ , how can we obtain homography  $H_{pr}$ ?

**A4:** A matriz  $H_{pr}$  pode ser obtida ao aplicar a inversa em  $H_{rp}$ .

(1):  $I_p$  to  $I_r = H_{rp}I_p$  then

$I_r$  to  $I_p = H_{rp}^{-1}I_r$  then

$H_{rp}^{-1} = I_pI_r^{-1}$  then

$H_{pr} = I_pI_r^{-1}$