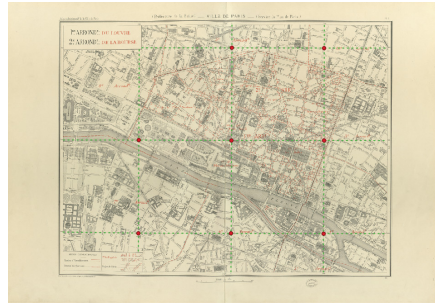


## Locating the Graticule Lines Intersections

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### 1 Introduction

The method for locating the graticule lines intersections was proposed to solve the Task 3 of ICDAR 2021 Competition on Historical Map Segmentation organized by Carlinet et al. (2021). Graticule lines (see fig. 1) are lines indicating the North/South/East/West major coordinates in the map and their intersections are very useful to geo-reference the map image.



**Figure 1:** Graticule lines (green) and their intersections (red). Carlinet et al. (2021)

### 2 Method description

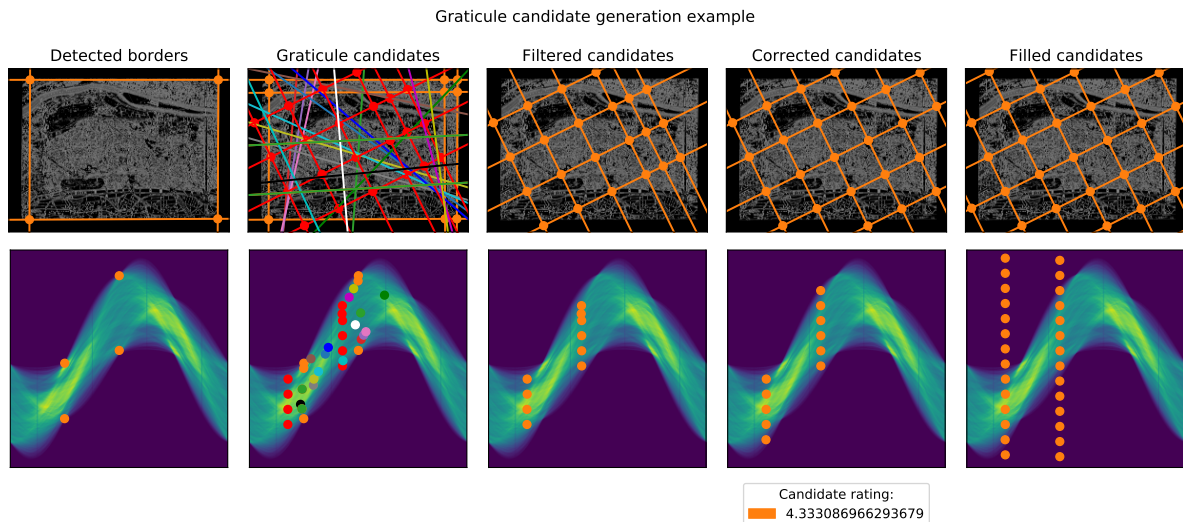
For localization of the graticule lines intersections, we first locate the graticule. The method uses the binarized image and Hough Line Transform. First, the input image is binarized using method proposed by Nina et al. (2011). Ideally, the binarization method should preserve the graticule lines and filter noise to achieve good results. Then, the Hough Line Transform is applied on the binarized image.

The lines can be located as local peaks in Hough accumulator. According to the fig. 2, the main steps are finding, filtering, correcting, filling and rating peak groups that represent the graticule candidates in Hough accumulator.

The graticule candidate can be identified using Hough accumulator, although it contains a large amount of noise, given by the following presumptions (the first three presumptions does not have to be fully satisfied but they affect the results):

1. graticule lines are straight
2. same distance between graticule lines
3. graticule lines are parallel or perpendicular
4. there are at least four graticule lines

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**Figure 2:** The process of locating the graticule in the image (upper) using Hough accumulator (bottom). The peaks in Hough accumulator represent the lines.

Every graticule candidate contains information about its rating, angle and distance between lines. Since we have generated several graticule candidates, we can select the best one according to its rating and expected distance. After that, we locate graticule lines intersections.

### 3 Results

The proposed method shows good results even on noisy historical map images. Generally, it can be also used for detection of graticule in images different to historical maps. It reached the first place in the competition with 92.5 detection score on the private test dataset.

### References

- Carlinet, E., Chazalon, J., Chen, Y., Duménieu, B., Géraud, T., Mallet, C., Perret, J. (2021). ICDAR 2021 Competition on Historical Map Segmentation. Task 3: Locate Graticule Lines Intersections. <https://icdar21-mapseg.github.io/tasks/task3/>
- Nina, O., Morse, B., Barrett, W. (2011) A recursive Otsu thresholding method for scanned document binarization *2011 IEEE Workshop on Applications of Computer Vision (WACV)*, pp. 307–314, IEEE