

Crack on runaway: A brainstorming

Teuku Abdullah Sanny¹, Sparisoma Viridi²

¹Seismology Exploration and Engineering Research Group

²Nuclear Physics and Biophysics Research Group

Institut Teknologi Bandung, Bandung 40132, Indonesia

20221104-v2 | <https://doi.org/10.5281/zenodo.7278924>

Outline

- Runaway layers 3
- Inspection of runaway 7
- Crack detection 10
- Others 17

Runaway layers

Crack relief layer (CRL)

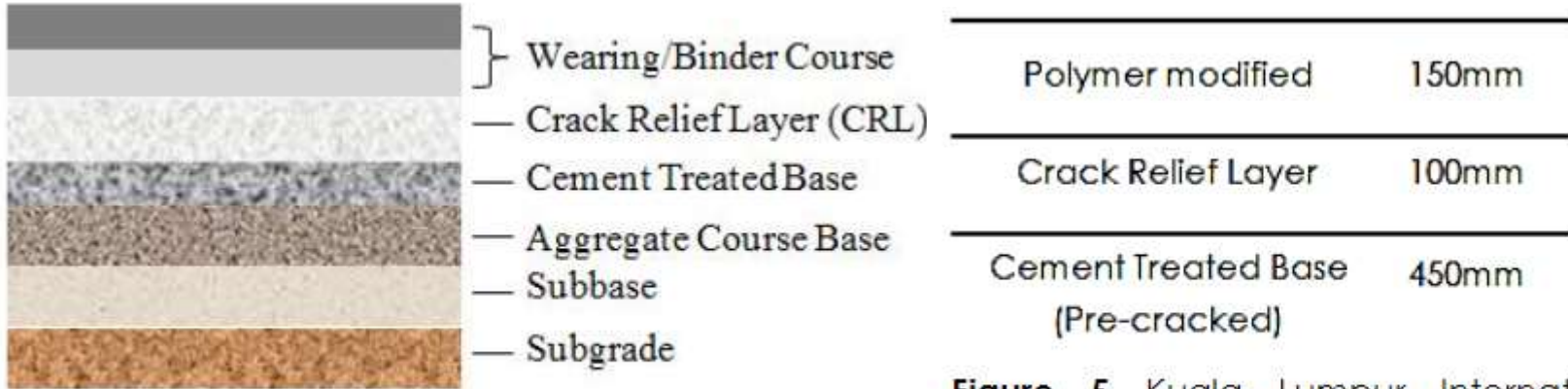


Figure 3 Placement of CRL in pavement strata [18]

Figure 5 Kuala Lumpur International Airport runways structure [1]

Ashraf Ahmad Zaini, Md Maniruzzaman A. Aziz*, Khairul Anuar Kassim, Khairul Hafiz Mustafa, "A Review on Crack Relief Layer in Airport Runaway", Jurnal Teknologi, 78(7-2), Jul 2016, url <https://doi.org/10.11113/jt.v78.9477>.

Crack relief layer: Development stages

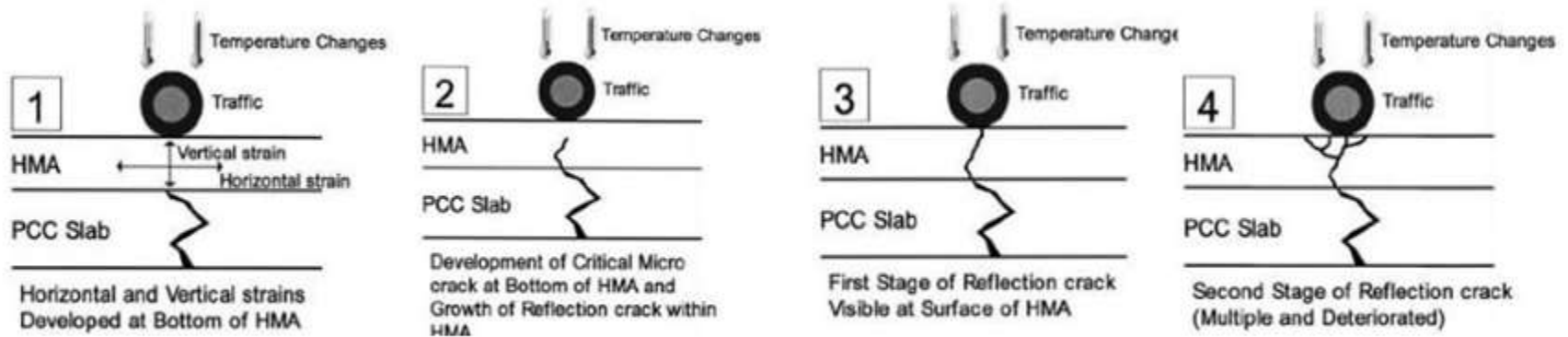


Figure 1 Different Stages in Development of Reflection Cracking on HMA Overlays [3]

Crack relief layer: Thickness comparison

- Cement treated based (CBT).
- In cement-treated base construction the objective is to obtain a thorough mixture of an aggregate /granular material with the correct quantity of Portlandcement and enough water to permit maximum compaction.

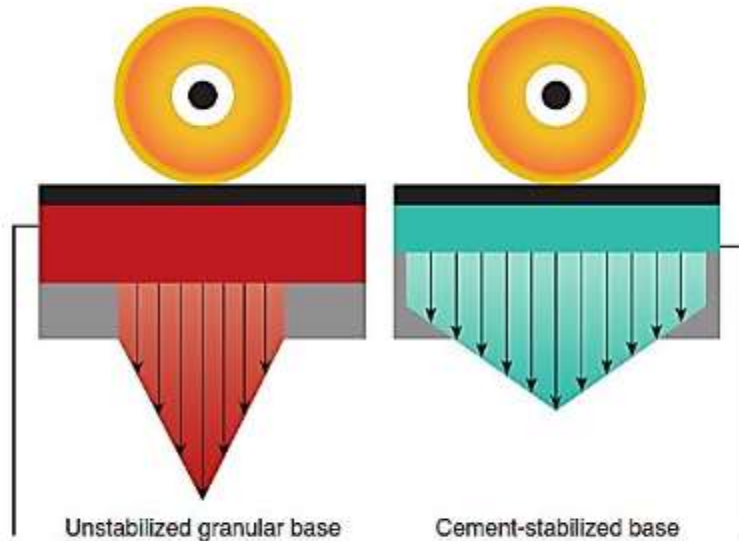
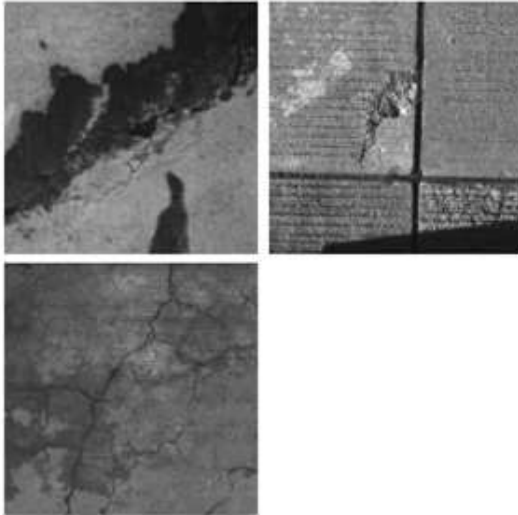


Figure 2 Comparison of thickness between normal granular base and CTB [22]

Inspection of runaway

Inspection with robot

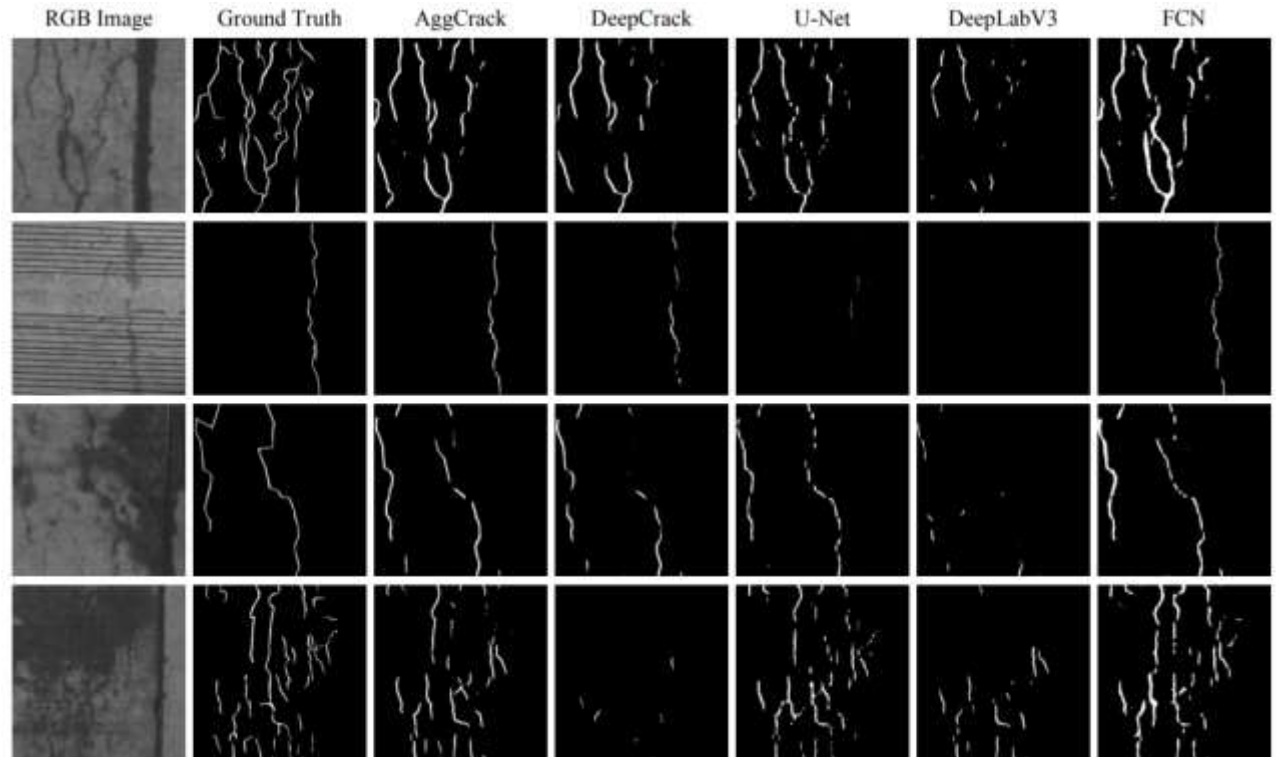
- Multi modes scanning.



Haifeng Li, Jianping Zong, Rui Huang, Zhongcheng Gui, Dezhen Song, “AggCrack: An Aggregated Attention Model for Robotic Crack Detection in Challenging Airport Runway Environment”, 2022 IEEE 18th International Conference on Automation Science and Engineering (CASE), 2022, pp. 1747-1752, url <https://doi.org/10.1109/CASE49997.2022.9926470>.

Inspection with robot: Results

- Example results of different algorithms on APD dataset.



Crack detection

Approaches

- Images are processed, e.g. filtered, segmentation, to obtain the features.
- Images are learned to, e.g. using Machine Learning, to obtain the features.
- Generally human eye (from expert) can sense the features.

Twice-threshold segmentation

- Processing flow chart is on the right.
- Media filter:

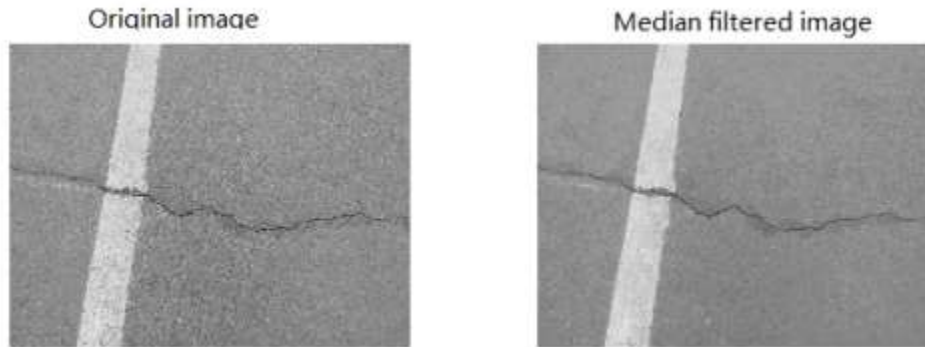


Figure 2. Image after median filtering

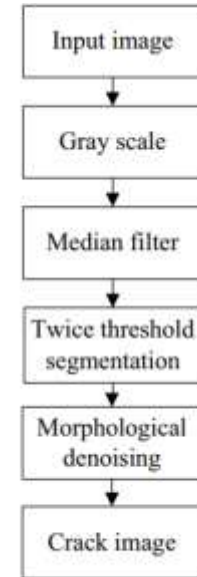


Figure 1. Runway image processing flow chart

Li Peng, Wang Chao, Li Shuangmiao, Feng Baocai, "Research on Crack Detection Method of Airport Runway Based on Twice-Threshold Segmentation", 2015 Fifth International Conference on Instrumentation and Measurement, Computer, Communication and Control (IMCCC), 2015, pp. 1716-1720, url <https://doi.org/10.1109/IMCCC.2015.364>.

Twice-threshold segmentation: Results

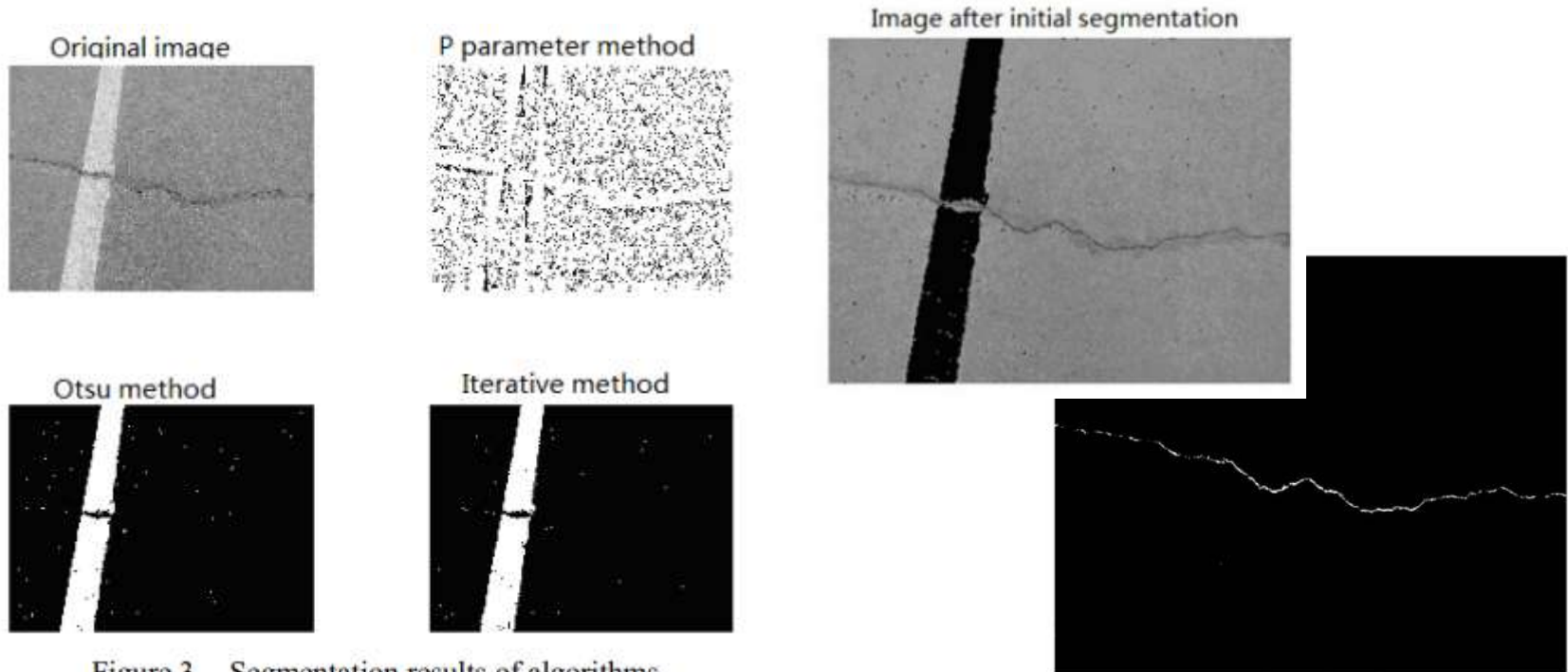


Figure 3. Segmentation results of algorithms

Figure 6. Crack image after the twice-threshold segmentation

YOLOv5

- Crack types:
 - horizontal,
 - longitudinal,
 - net.
- There are relatively few net cracks, the other types occupy a large proportion in the data.

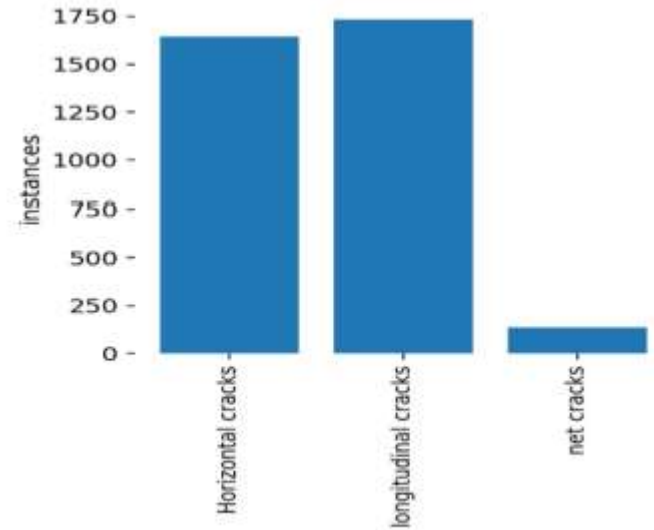


Fig. 5. The different classes about cracks

Bu Li, Maoming Fu, Qin Li, “Runway Crack Detection Based on YOLOV5”, 2021 IEEE 3rd International Conference on Civil Aviation Safety and Information Technology (ICCASIT), 2021, pp. 1252-1255, url <https://doi.org/10.1109/ICCASIT53235.2021.9633666>.

YOLOv5: Labeling

- Data sets are labeled before training.
- Expert justification is required.



YOLOv5: Results

- Confidence = 0 means no target in the frame.
- Confidence is the probability of existence of an object in the frame.



Fig. 7. The detecting result



A horizontal bar chart with a blue bar. The bar is labeled 'Others' in white text. The bar is positioned on the right side of the chart area.

Others

YOLOv5

- YOLO: You Only Look Once.
- It is one of the most popular and most favorite algorithms for AI engineers.
- It always has been the first preference for real-time object detection.
- YOLOv5 is released in 9 June 2020.

Mihir Rajput, "YOLOv5 is Here! Elephant Detector Training Using Custom Dataset & YOLOV5", Towards Data Science, 15 Jun 2020, url <https://towardsdatascience.com/x-b668ce2a4908> [20221103].



Thank you

.., url <https://> [20221103]