Research Internship Proposal

Title of the internship

Development of an automatic crack inspection tool based on Machine Learning and 2D Huang-Hilbert transform.

Host research laboratory

LINEACT cesi

https://lineact.cesi.fr/en/

Academic referent of the internship:

Dr. NAIT CHABANE Ahmed
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Partner research laboratories

MANIPAL UNIVERSITY JAIPUR https://jaipur.manipal.edu/muj/research.html *Academic referent:* Prof. (Dr.) Rajveer S. Shekhawat, SM-IEEE, SM-ACM Dean-FoE & Director-SCIT Manipal University Jaipur, INDIA Email: rajveersingh.shekhawat@jaipur.manipal.edu	https://icp.edu.pk/index.php *Academic referent:* Dr. ISLAM Naveed Associate professor and Head of the computer science department, PAKISTAN. Email: naveed.islam@icp.edu.pk

Context

Infrastructures and roads are subject to continuous mechanical stress and changes in temperature and humidity. These factors participate in increasing the fatigue and aging of the materials constituting a given structure. To ensure safety and maintenance during the life cycle of infrastructure, government authorities and industries allocate budgets for the inspection and maintenance of buildings, monuments, roads, dams and pipelines. Early detection of cracks enables preventive measures to be taken and possible damage to structures [1]. Traditional technique based on manual crack inspection can be precise in some cases, but subjective and require technical expertise of operators in crack analysis, more expensive and time-consuming [2]. In addition, access to certain constrained and dangerous environments complicates the monitoring of structures and endangers human inspectors [3]. As an alternative to handcrafted methods, automatic and semi-automatic techniques are increasingly used and contribute significantly to improving the detection and reliable monitoring of cracks with less risk to human operators. These new techniques are boosted by the considerable advances in robotics, machine learning and image processing algorithms. An autonomous system, which can quantify, locate and classify different crack types and manage huge amount of data's collected is an essential one for automatic crack detection. So robust decision-making tools must be developed to allow fast analysis of the risk of every crack to fill the gap between the detecting cracks and helping asset managers to take action immediately.

Mission

The objective of this internship is to propose an automatic methodology for images cracks detection and classification using Machine leaning. The main outcomes of this internship are:

1. The first step is to propose and approach for images cracks classifications and segmentation in relation with the state of the art;
2. The second step consists of implementation of the proposed approach and test its performance on a real data set;
3. The third stage concerns characterization of the cracks (width, length…) for for further use in inspection plans;
4. Implementation of the proposed approach on a robot using simulation (ROS, Gazebo).

Skills

- Image Processing, Machine Learning and Features extraction.
- Python,
- ROS and Gazebo Simulator (is a plus for the internship).

Resources

- Articles
- Software: Python
- Data sets of 40000 cracks images for experiment.

Information about the internship

Location :

Campus CESI Saint-Nazaire
1 boulevard de l'Université
CS 70152 44603 Saint-Nazaire.
https://g.page/campus-cesi-stnazaire?share

Duration: 5/6 months

Starting date: March, 2022

Supervisor: Dr. NAIT CHABANE Ahmed (anaitchabane@cesi.fr)

References

1. D. Dhital, J.-R. Lee, A fully non-contact ultrasonic propagation imaging system for closed surface crack evaluation, Experimental mechanics, 52 (8) 90, (2012) 1111–1122.
2. R. Fan, Real-time computer stereo vision for automotive applications, Ph.D. thesis, University of Bristol (2018).
3. H. Sohn, Y. Lim, K. Yun, G. Kim, Monitoring crack changes in concrete structures, Computer-Aided Civil and Infrastructure Engineering 20 (1)
4. P. Reddy B. and V. C.M., "Crack Detection Robot in Underground Gas Pipelines using FPGA," 2019 IEEE 5th International Conference for Convergence in Technology (I2CT), 2019, pp. 1-5.
5. Arun Mohan, Sumathi Poobal, Crack detection using image processing: A critical review and analysis, Alexandria Engineering Journal,
   Volume 57, Issue 2, 2018, Pages 787-798, ISSN 1110-0168.
6. Huang, Norden Eh. Hilbert-Huang transform and its applications. Vol. 16. World Scientific, 2014.