Use of Computer Vision for Crack Detection

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supervised by

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Introduction

Recently graduated with BA(Hons)/MEng in Civil, Structural and Environmental Engineering from University of Cambridge

MEng project on Fibre Optics Strain Measurment (BOTDR) in Reinforced Concrete Structure

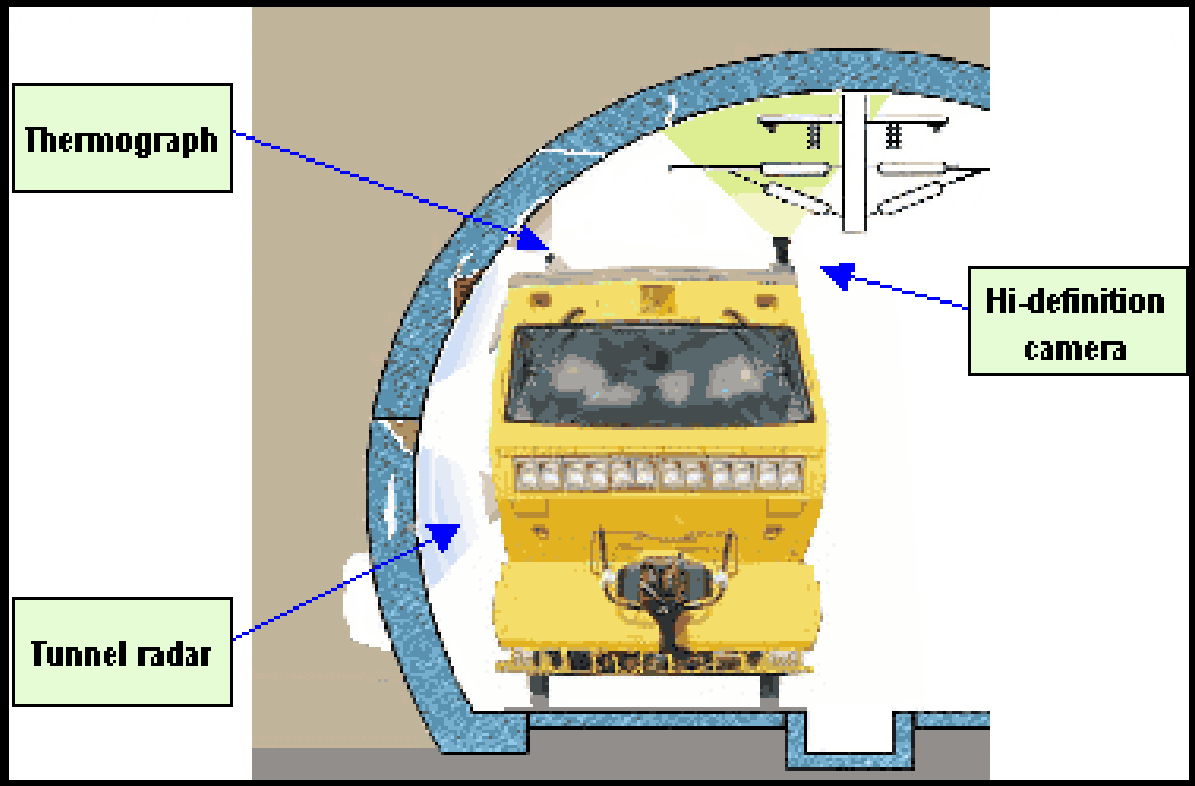
Official start the PhD study in Computer Vision in Geotechnical Engineering in October 2007

Outline

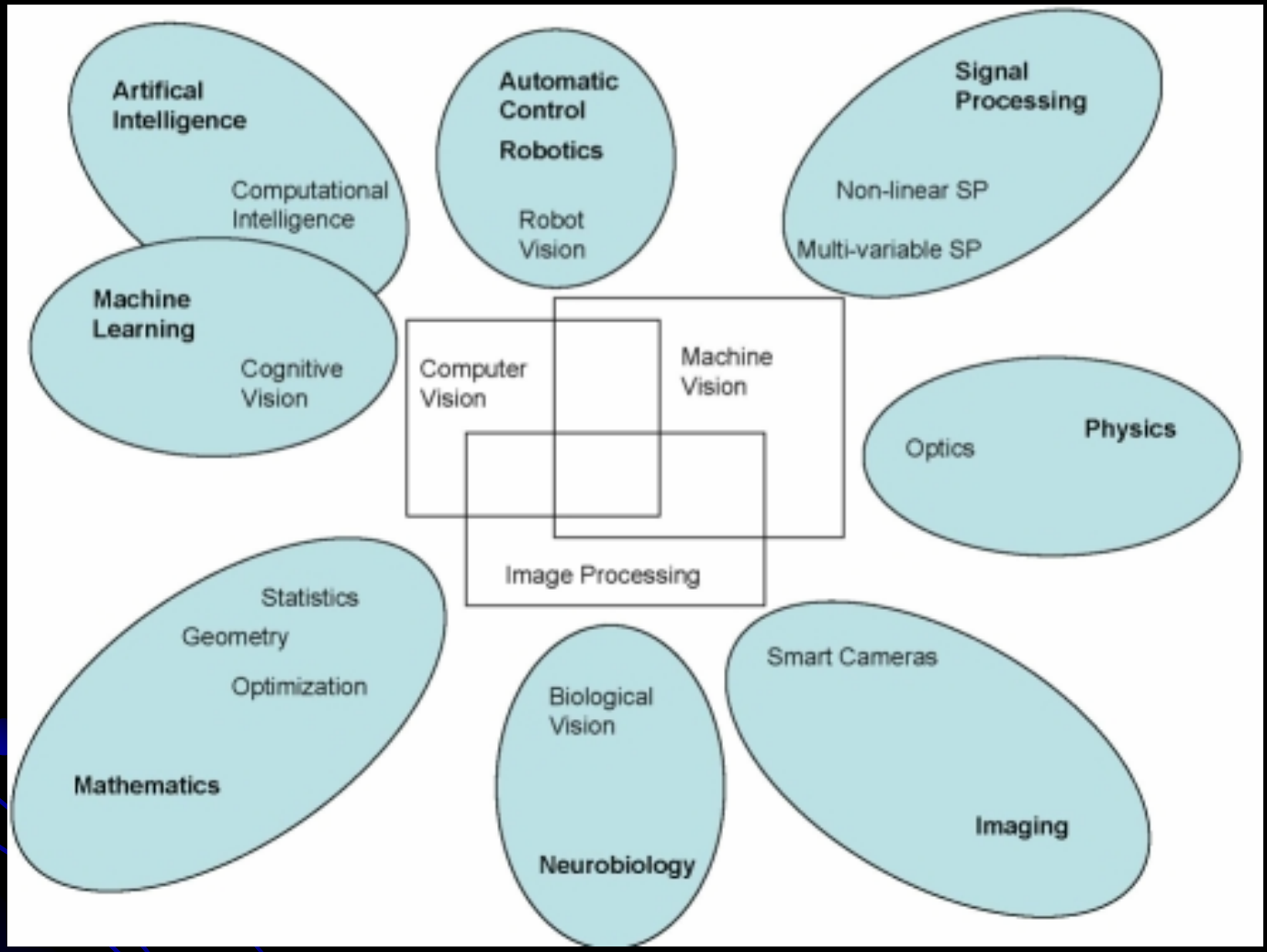
- Current technologies for tunnel inspections
- Computer vision in Underground M^3
- Review of some literatures
- Possible future plan

Current use of imaging techniques for infrastructure assessment

- Paris metro: Use of laser scanner for image acquisition
- Sankyo Co. Japan: Recording of images using high-resolution digital cameras ($18-25- m^2)
- Keisoku Kensa Co. Japan: Crack detection system: Use of high speed video camera ($65k/day)



Tunnel Inspection System, Takenaka Civil Engineering & Construction Co., Ltd



Focus on Computer Vision (CV) and Machine Learning (ML)

Crack detection/localization

Two steps:

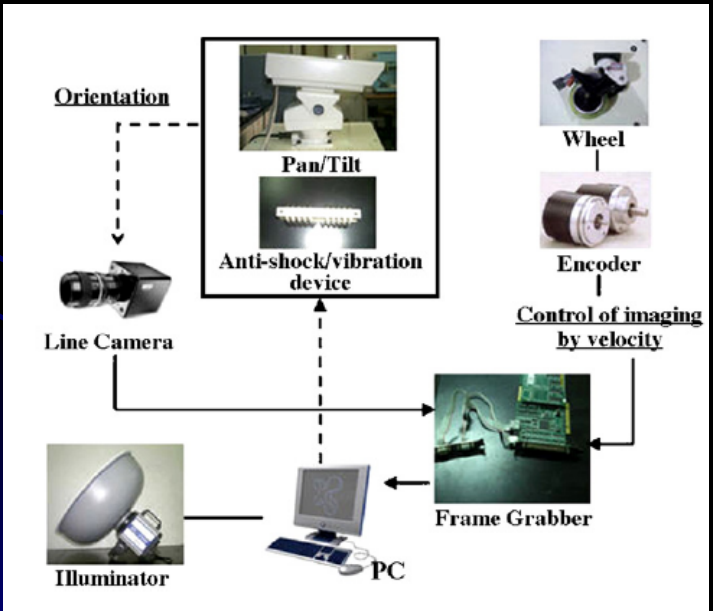
Crack extraction using computer vision techniques (e.g. edge, corner, line, pattern detection)

Crack recognition by machine learning (e.g. support vector machine(SVM) and neural networks)

Above approaches must be together in order to achieve crack detection algorithms

Image processing

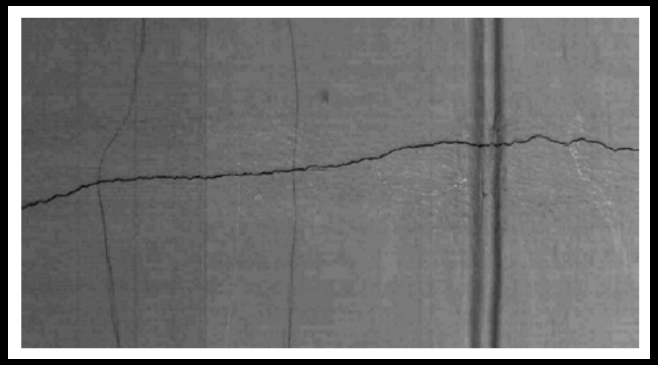
Yu et al. (2006) proposed an inspection system, consisted of a mobile robot with Charged Couple Device(CCD) for data acquisition and crack detection system using image processing.

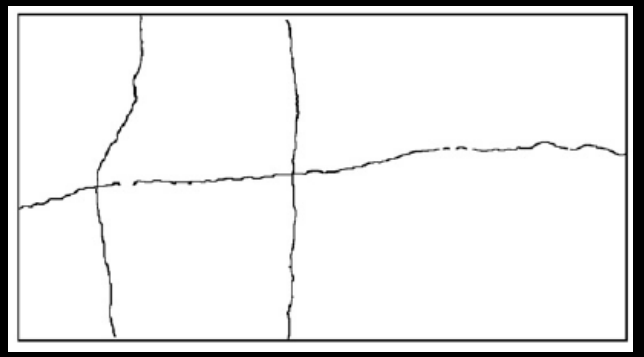


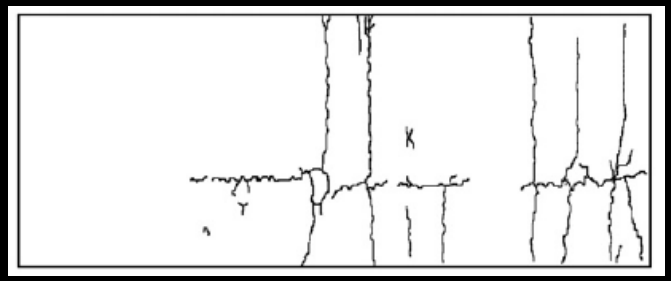
Cracks and non-crack areas are distinguished by their light reflectance values

Cracks are extracted by graph search method with given start and end points

Results

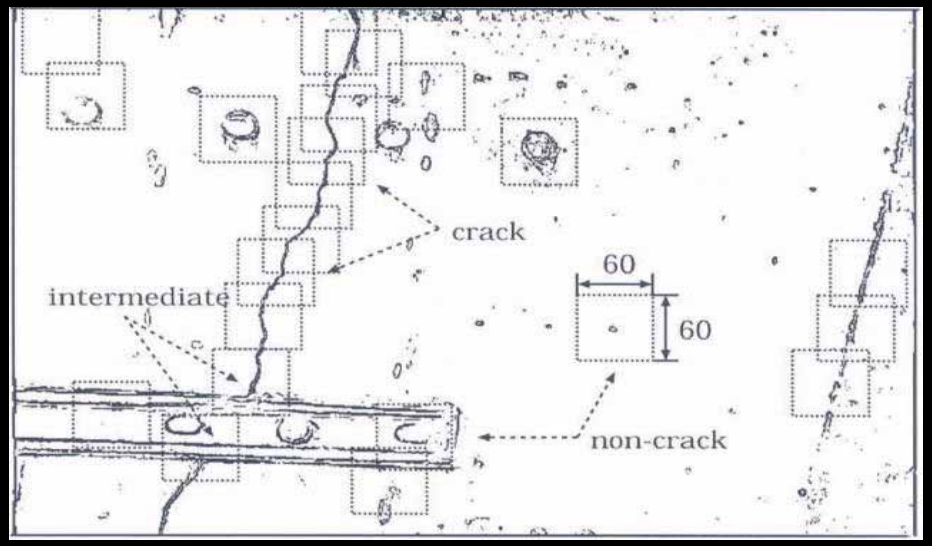






- Erroneous recognition of cracks and non-cracks prevails
- Used semi-automated system to discard erroneous points
- Further works such as a study of crack characteristics and development of fully automated software

Support Vector Machine



Zhiwei et. al.(2002) used crack intensity feature to detect crack edges (Discriminant Analysis Method). However other non-crack image may be extracted.

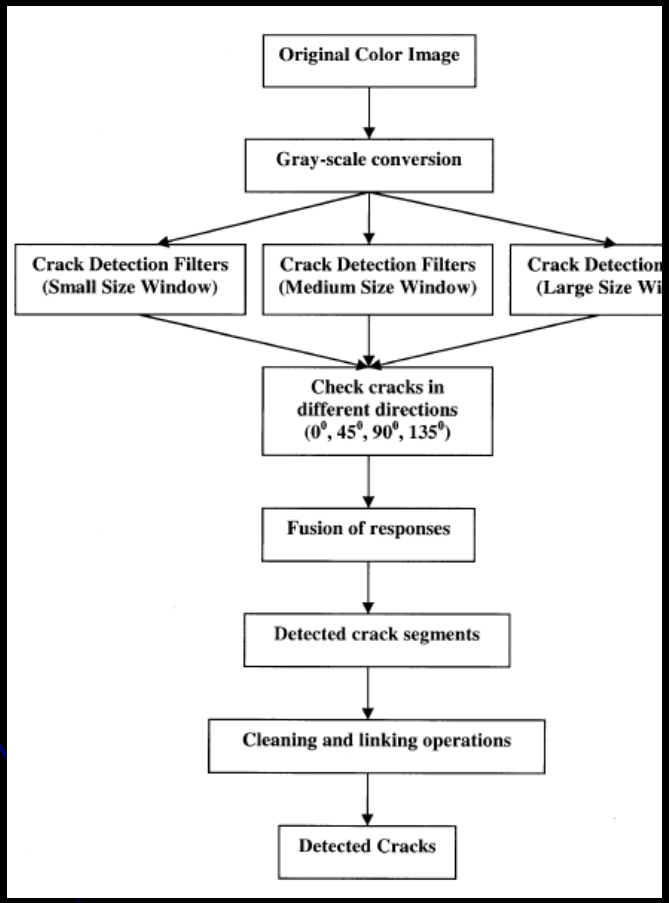
SVM is used to classify into crack, non-crack and intermediate image. Experimented by balanced and unbalanced sub-image.

Results

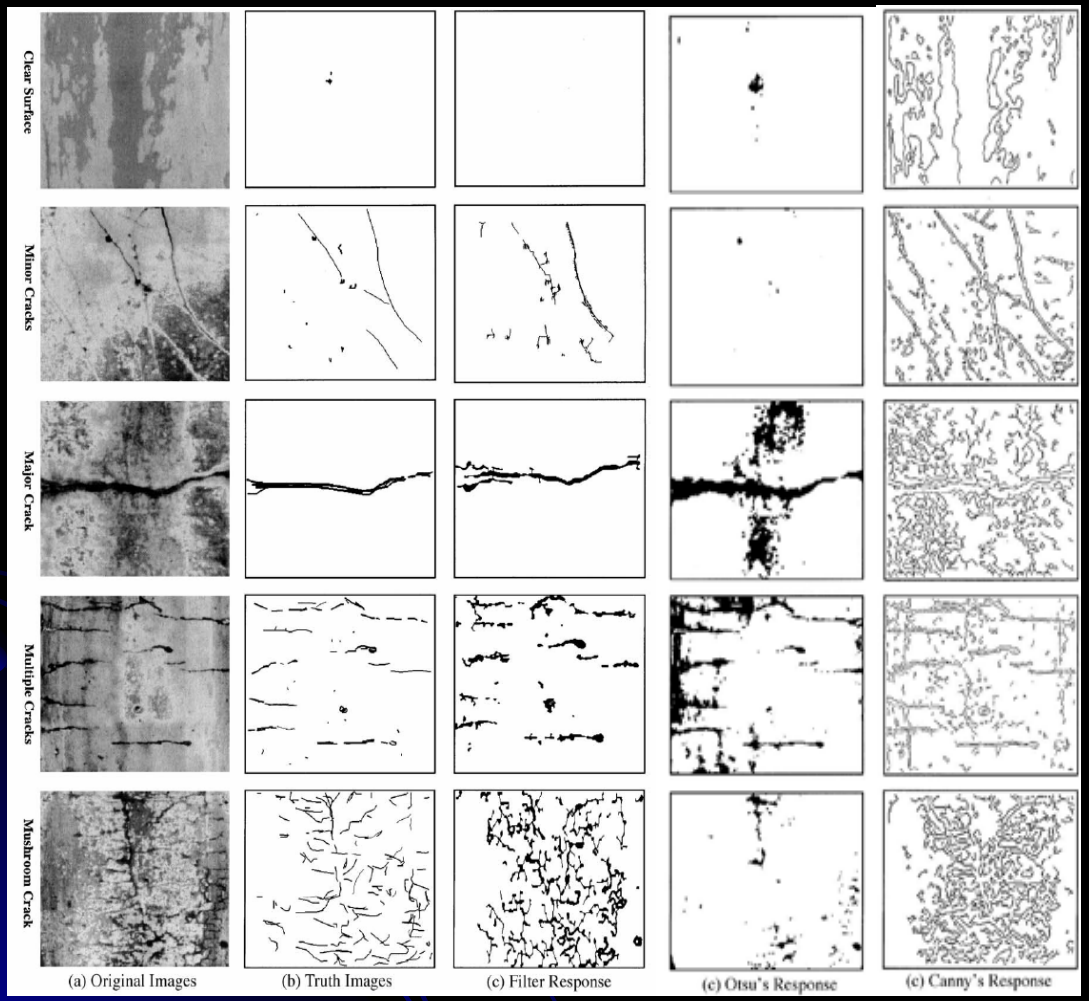
- Balanced sub-image is more effective than unbalanced sub-image
- Use image features to enhance image recognition
- Only linear cracks were considered
- SVM need further development

Automated detection of cracks in buried concrete pipe images (Computer Vision)

Sinha et. al.(2005) proposes approach for crack detection in pipes.



Results



Results were good since cracks in pipe images were clearly visible pattern

This paper present excellent system of comparing qualitative values such as visual comparison, correctness, and completeness

Image of mushroom cracks were not as good

How may we go from here?

- Improve the methods of crack extraction
- Improve the methods of crack recognition based on new techniques such as boosting
- High accuracy of crack detection algorithms to enable evaluation of crack sizes
- The characterization module would recognise cracks from the images and classify them into deterioration categories

Thank you for your attention