Qasr al-Hajj, Lybia: an example of earthen architecture

# FROM THE CRACKS IN THE RUINS, THE ELECTROCARDIOGRAM OF HISTORY

> On earth, of earth, there are buildings, there are homes, at the intersection of a culture, an art and a science, dating back many years, as far back as a man, whose ruins are narrating a history.

A RESEARCH TALE BY

Mahshid Zeighami Moghaddam

DEPARTMENT

Chemistry

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Ever listened? Have we ever listened to the untold, to the silence of our friends, colleagues, the loved ones or the strangers, when it really does speak!

In the framework of Tech4Culture, we are listening to the history arrested in the cracks of one of the earliest creatures of our own selves, our buildings, our made of earth homes, that once we created and then they created us, our identity, culture and heritage, our codes of behaviour, comfort and well-beings. We are offering our ears to their wounds, that bearing the burden of a lifetime incidents throughout history have opened their mouths.

I completed my Advanced Master in Structural Analysis of Monuments and Historical Constructions (SAHC) at the University of Padova and University of Minho. Under the supervision of Professor Monica Gulmini, we are currently conducting this research project in Turin on scientific and technological aspects of conservation of rammed earth heritage.

Earthen structures are essential elements of world heritage. Among the most widely documented structural types, rammed earth is significantly spread. Conservation and restoration of earthen cultural heritage are firmly bound to the identification and characterization of existing cracks, which provide accurate quantitative data upon which conservation strategies are based. Severe

cracks may propagate along the surface of an earthen wall, which may lead to severe structural problems and failure. This fact highlights the need to point out crack regions and manage surface cracks from their early stage from the safety point of view, which is fundamental for preservation actions. We are utilizing and developing digital examination, edge detection, techniques to identify edges of their cracks, to see the disregarded for many years. In this context, part of my research includes a machine learning approach for solving a real-world pattern recognition problem by transforming a surface image into an intermediate representation, which in turn can provide a set of mathematical rules for desirable tasks such as crack detection.

At the diagnosis sections we are listening to the very heart of rammed earth by looking at their electrocardiograms, the graphs of the waves transmitted through, the output of the portable ultrasonic pulse velocity testing instrument. We are measuring the propagation velocities of the compression and shear waves, and thus the Young's modulus of elasticity.
Through compression in vertical direction testing, we are experimenting the way they carry life compression. We are performing uniaxial compression tests on compacted earth material.

We hope passing this information would aid the specialist conservators to prescribe the best remedies to heal them, whose healing heals ourselves, and to conserve them, whose conservation preserves our own selves and the earth.

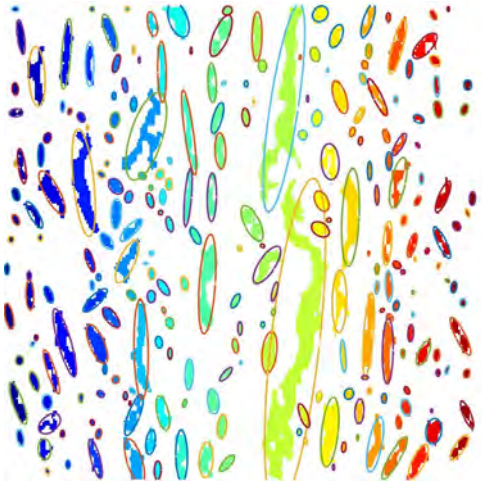

Fig. 1 - Geometrical component map for crack and non-crack features

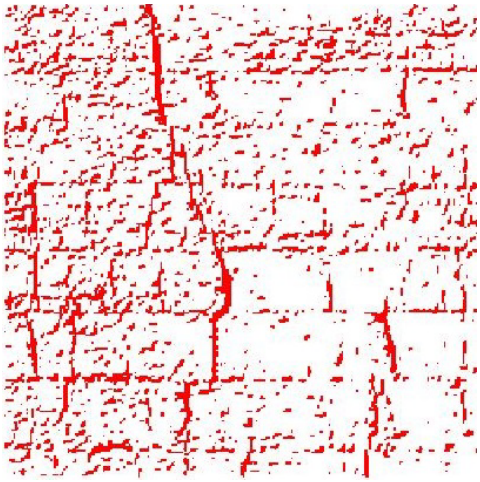

Fig. 2 - Edge detection on surface image of rammed earth wall

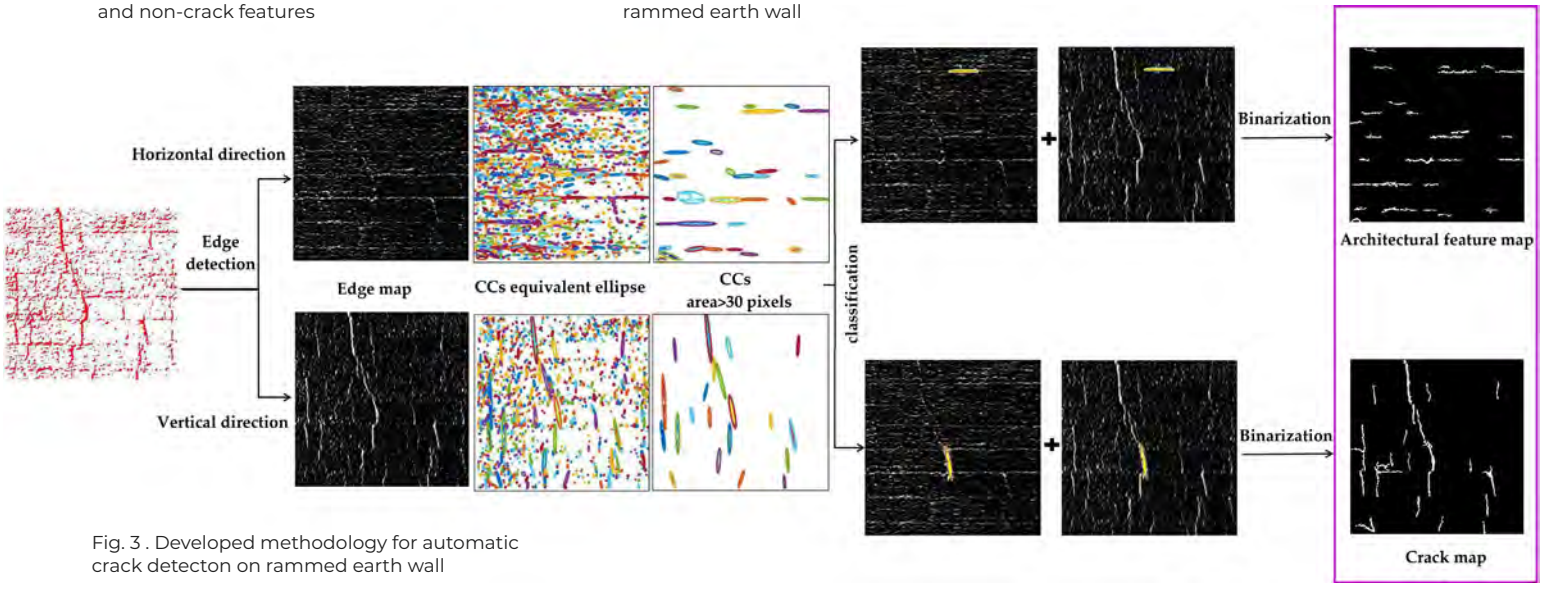


Fig. 3 . Developed methodology for automatic crack detecton on rammed earth wall