

# ANNFASS: A Neural Network Framework for understanding historical monuments Architectural Structure and Style.

Melinos Averkiou<sup>1†\*</sup>, George Artopoulos<sup>2\*</sup>, Evangelos Kalogerakis<sup>3†</sup>, Gustavo Patow<sup>4§</sup>,  
Maria Igarievna Maslioukova<sup>5\*</sup>, Marissia Deligiorgi<sup>6\*</sup>, Yiorgos Chrysanthou<sup>7†\*</sup>

<sup>1</sup>*RISE, 1 Constantinou Paleologou, Tryfon Building, 1011, Nicosia, Cyprus*

<sup>\*</sup>*The Cyprus Institute, 20 Konstantinou Kavafi Str., 2121, Aglantzia, Nicosia, Cyprus*

<sup>†</sup>*University of Massachusetts Amherst, 140 Governors Dr, Amherst, MA 01002, USA*

<sup>§</sup>*Universitat de Girona, Plaça Sant Domènec, 3 Edifici Les Àligues, 17004, Girona*

*University of Cyprus, 1 Panepistimiou Av., 2109, Aglantzia, Nicosia, Cyprus*

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## Abstract

In today's society, cultural heritage occupies a central role in the process of bringing together different ethnic groups, allowing them to live together peacefully. This is especially true for Cyprus, where the Greek-Cypriot and Turkish-Cypriot communities have been divided for half a century. Tangible cultural heritage contains large amounts of historical artefacts that are constantly digitized and catalogued as part of the conservation process. Historical monuments are especially hard to document due to historic transformations, destruction, reuse of material, and urban development that covers traces and changes the spatial configuration of the site. The aim of this paper is the presentation of a tool developed for the digitization of cultural heritage buildings and aid their examination with the use of ANNs for the classification of a monument's structure and style.

Recent technological advances in the fields of computer vision and computer graphics allow us to reality capture the complex geometry of historical monuments and represent it in 3D space. This kind of 3D data are valuable to heritage experts since they offer detailed information related to a building's geometry. Furthermore, machine learning has been progressing, with the use of deep learning, offering us the chance to create automated tools. ANNFASS employs such techniques to develop a novel framework for monument study and understanding. This framework consists of 3 parts, a monument database, and two platforms, one for building structure and style analysis, and one for design rule identification and comparison. The presented platform offers the user a pool of monuments organised by historical period to examine, while the ANNs strive to label the monument's components (e.g., door, window, roof) and classify the architectural style and time period (e.g., ottoman, byzantine, gothic) of unknown monuments that have been added to the platform. Furthermore, with the use of grammar extraction methods, the design / construction rules of a monument will be indicated and compared side by side with those of other monuments.

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<sup>1</sup> [m.averkiou@rise.org.cy](mailto:m.averkiou@rise.org.cy)

<sup>2</sup> [g.artopoulos@cyi.ac.cy](mailto:g.artopoulos@cyi.ac.cy)

<sup>3</sup> [kalo@cs.umass.edu](mailto:kalo@cs.umass.edu)

<sup>4</sup> [dagushh@gmail.com](mailto:dagushh@gmail.com)

<sup>5</sup> [migari01@cs.ucy.ac.cy](mailto:migari01@cs.ucy.ac.cy)

<sup>6</sup> [m.deligiorgi@cyi.ac.cy](mailto:m.deligiorgi@cyi.ac.cy)

<sup>7</sup> [y.chrysanthou@rise.org.cy](mailto:y.chrysanthou@rise.org.cy)

It is also worth mentioning that it is the first time 3D models of buildings are used in such an enquiry, that differs from previous methods which were limited to using 2D data for relevant monument analysis studies. ANNFASS's novel framework offers a variety of tools that can benefit scholarly research internationally. Specifically, the ANNFASS database can be updated with multicultural / multi-period monuments, which in turn will be used to enrich the feature learning for the structure and style recognition ANNs. Lastly, these tools are not confined to cultural heritage but can be well-applied in the analysis of modern buildings by architects and engineers, contributing to scientific excellence in architectural history, education and research.

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