

# Chapter 5

## 3D Modelling and Artificial Intelligence: A Descriptive Overview

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### ABSTRACT

*This paper explains the different interactions between the Artificial Intelligence (AI) techniques and 3D modelling, not only the wide-used application of AI in order to the implementation of 3D environments, but the less explored use of 3D models in order to take advantage from AI techniques. The authors will be especially interested in real Engineering applications, but the techniques presented in this paper are general and can be used in other research fields. Moreover, a particular robotic application is shown.*

### INTRODUCTION

The amazing growth and development of technology features in 20<sup>th</sup> and 21<sup>st</sup> centuries have implied the coining of new terms. One of the most known is that of Artificial Intelligence, born in the 50s,

that includes a wide range of topics and tools, such as Logic, Neural networks, classifiers, statistical learning methods, etc.

AI domains clearly interact with other research activities, since it is an extremely wide field. This paper focuses on the exploration of these interactions related to 3D modelling.

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3D modelling can be defined as

*the process of developing a mathematical, wire-frame representation of any three-dimensional object (either inanimate or living) via specialized software. The product is called a 3D model (Wikipedia, 2009).*

Keeping in mind this definition, it is clear that 3D modelling and Artificial Intelligence (AI) are not disjoint researching fields but several interactions between these fields occur. These interactions usually require the joint work of specialists in different disciplines. A field where these are interactions have been shown as useful is that of Engineering, and in particular Robotics: simulation of real devices, artificial vision, virtual environments, etc. However the authors consider that this field has not taken completely advantage from the potential that this interaction offers.

The objectives of this paper can be summarized as follows:

1. 3D modelling and Artificial intelligent are usually applied in different engineering problems in an independent way. However, this chapter will be show the interest of fusing both approaches.
2. Different hybrid approaches will be presented, where 3D modelling and Artificial Intelligence are combined.
3. A new perspective will be shown, where the 3D Modelling is used as a resource for collecting the data. These data could be used as a source data, necessary to apply an intelligent strategy to a particular engineering problem.

## BACKGROUND

Humans are used to interpret bidimensional images as part of a three dimensional world. However computers have not this spatial reference. So,

artificial vision, means, mainly, to create a 3D virtual model based on a bidimensional image captured by an artificial eye (such as a camera or similar). In this context, researchers can simulate the human stereovision and capture several images at the same time (human vision use two images to create a 3D model), but in a lot of problems only a single image is available. In both cases, the computer recognizes and understands the 3D space, usually making use of mathematical methods to solve the problem but also a certain amount of intelligence.

These mathematical methods are based on nonlinear partial differential equations, stochastic and statistical methods, and signal processing techniques, as Wavelet and other transform types. These techniques achieve image smoothing and denoising, image enhancement, morphology, image compression, and segmentation (determining boundaries of objects, including problems of camera distortion and partial occlusion). The development of the theory is fundamental since it enables achieve the high level vision. Some examples of this are stochastic processes, that they have been used in a Bayesian framework to incorporate prior constraints on smoothness and the regularities of discontinuities into algorithms for image restoration and reconstruction. This has a considerable number of applications such as handwriting recognizers, printed-circuit board inspection systems and quality control devices, motion detection, robotic control by visual feedback, reconstruction of objects from stereoscopic view and/or motion, autonomous road vehicles, and many others.

Other field where AI has been included is in the design of intelligent behaviour of 3D elements, mainly focused in Entertainment and Education fields, such as intelligent agents virtual environments, computer games, online social worlds and educational platforms. Recent advances in Multimedia and Internet technology are giving rise to interactive virtual worlds, which are essential for certain types of applications, both

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