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Abstract

Template-Based reverse engineering approaches represent a relatively poorly explored strategy in the field of CAD reconstruction from polygonal models. Inspired by recent works suggesting the possibility/opportunity of exploiting a parametric description (i.e. CAD template) of the object to be reconstructed in order to retrieve a meaningful digital representation, a novel reverse engineering approach for the reconstruction of CAD models starting from 3D mesh data is proposed. The reconstruction process is performed relying on a CAD template, whose feature tree and geometric constraints are defined according to the a priori information on the physical object. The CAD template is fitted upon the mesh data, optimizing its dimensional parameters and positioning/orientation by means of a particle swarm optimization algorithm. As a result, a parametric CAD model that perfectly fulfils the imposed geometric relations is produced and a feature tree, defining an associative modelling history, is available to the reverse engineer. The proposed implementation exploits a cooperation between a CAD software package (Siemens NX) and a numerical software environment (MATLAB). Five reconstruction tests, covering both synthetic and real-scanned mesh data, are presented and discussed in the manuscript; the results are finally compared with models generated by state of the art reverse engineering software and key aspects to be addressed in future work are hinted at.

Keywords: Reverse engineering; CAD reconstruction; CAD template; 3D mesh; Constrained Fitting; Particle Swarm Optimization.

1. Introduction

RE: Reverse Engineering; CAD: Computer Aided Design; CAE: Computer Aided Engineering; TCRT: Template-Based CAD Reconstruction Tool; PSO: Particle Swarm Optimization; CSG: Constructive Solid Geometry; COM: Component Object Model;