Reverse Engineering of Pipe Layouts and 3D Point Set Damage Models

David Gallup and Thomas C. Henderson

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School of Computing
University of Utah
Salt Lake City, UT 84112 USA

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Abstract

This paper focuses on obtaining pipe layout information from depth images, and on the development of damage models for 3D shapes. Techniques are given for recognizing various pipes and pipe features. Methods for generating compact geometric descriptions of pipes and pipe features are discussed. These methods and techniques are analyzed for error, and error measurements are given. 3D shape damage models are proposed based on a separable Gaussian kernel model. Experiments on synthetic and real data were performed and results discussed.

1 Introduction

Surface curvature analysis is a powerful method for identifying pipes and pipe features in range images. Straight pipes, for example, are equivalent to cylinders which can be effectively identified by their surface curvature. Surface curvature for depth images can be calculated using Monge patch formulas. Once the depth image has been segmented into pipes and pipe features, additional work must be done to give a compact geometric description of these objects. For example, rather than describe a straight pipe as a region of surface points exhibiting cylindrical surface curvature, the pipe could be described as a line segment with a radius.