Boolean Operations on Rasterized Shapes Represented by Chain Codes Using Space Filling Curves

Borut Žalik, Domen Mongus, Krista Rizman Žalik, Niko Lukač

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Boolean Operations on Rasterized Shapes Represented by Chain Codes Using Space Filling Curves

Borut Žalik[1,2,*], Domen Mongus, Krista Rizman Žalik, Niko Lukač

[a] *University of Maribor, Faculty of Electrical Engineering and Computer Science, Smetanova 17, SI-2000 Maribor, Slovenia*

Abstract

This paper introduces a new algorithm for Boolean operations on rasterized geometric shapes that are represented with chain codes. The algorithm works in three steps. Firstly, the chain code symbols are transformed in the Hilbert space, where the overlaid chain code symbols are recognised. After that, a suitable starting cell is determined. Finally, the walk-about through the sequence of the initial chain code symbols is performed to obtain the sequence of chain code symbols representing the shape of the required Boolean operation. The algorithm is demonstrated on Freeman chain code in four directions. The time and space complexity of the proposed algorithm is linear, which was proven theoretically and confirmed by experiments.

Keywords: Chain codes, Space filling curves, Hilbert curve, Boolean operations.

1. Introduction

Representation of rasterized geometric shapes requires a considerable amount of memory. A huge number of compression techniques were developed in the past for raster images [1]. However, these techniques do not consider individual geometric shapes, but rather deal with the raster image as a whole. If only individual shapes on the raster are important, the memory requirements for their representation can be reduced by storing only a shape's border pixels to obtain its boundary representation [2]. A sequence of neighbouring border pixels can be described efficiently by a chain code. The chain code is a small set of commands (represented by the chain code symbols) by which one can navigate through the boundary pixels of a shape. Various chain codes were proposed in the past, starting with the oldest and still the most popular Freeman chain code in eight (F8) and four (F4) directions [3]. The Vertex Chain Code (VCC) [4] and Three OrThogonal ($3OT$) [5] chain code were introduced later, while the Unsigned Manhattan Chain Code (UMCC) was proposed very recently [6]. Although the chain codes

*Corresponding author
Email address: borut.zalik@um.si (Borut Žalik)
URL: http://gemma.feri.um.si/ (Borut Žalik)
[1]Tel: +386-2-220-7471
[2]Fax: +386-2-220-7272