Abstract. This paper presents a blind and robust watermark approach for authentication 2D Map based on polar coordinates mapping and support vector machine is presented. The proposed system is composed of three phases. Firstly, in the preprocessing phase, the proposed algorithm mapped all vertices into polar coordinate system. Then, in the support vector machine phase, the watermark portable points will be chosen using support vector machine to reduce the number of these points which increases the imperceptibility without any effect on the robustness of the watermark. Afterwards, in the watermarking algorithm phase, the watermark is embedded into the map vertices using the random table of the decimal valued of the polar coordinates through the digit substitution of the decimal part. Finally, in the theoretical analysis and experimental results shows that the presented approach is robust against various attacks including rotation, scaling, and translation. The proposed approach attained high imperceptibility.

Keywords: Support vector machine, vector watermarking, authentication, and geographic information system.

1 Introduction

2D Vector data has a very useful application like computer aided design (CAD) and geographic information system (GIS) where it cost a huge amount of money and time to collect data as in GIS or to design as in CAD. vector maps based on GIS data are rigorous representations of a geographical region and are used for many purposes such as military and civil cartography, urban planning, forestry etc. In those maps, each geographical structure, as a roads, a river or mountain, is defined by a definite number of vertices set in a specific arrangement.
Production of GIS data is a heavy work. Thus, GIS data constitute a valuable asset which should be protected from digital piracy. The rapid growth of digital technology makes the modification, illegal copy and attack the digital data is simply moreover of intense image processing tools have also made digital image manipulations much easier. In such application of 2D vector data the demands of integrity and authenticity are very tough, and no deformation is permitted [1]. Recently, research on watermarking is concentrated on raster images [2], [3], [4], [5], [6], and [7].

When watermarking GIS data, we have to keep the data distortion low, i.e. the value of the coordinates of the vertices which define Map entities must to be very closely to the value of the coordinates in original map. There are two watermarking techniques when the researcher deal with vector data first one is transform domain techniques and the other is the spatial domain. the transform domain techniques first translate the spatial data into a transform domain and then apply the watermark in that domain The spatial domain techniques deal directly with the coordinates of vertices [9] [10]. Various transforms, like the Fourier descriptors [11] [12], wavelet transform [13] or mesh-spectral domain [14] have been used in the literature.

The watermarking of vector graphics have been developed in and several researches such as changing line features, insertion new vertices, and replacing existing stroke segments by new lines in a stylistic way are described in detail. They can achieve high capacity and robustness, but the watermark can be easily removed by attacks designed specifically for each method. A method for hiding data in curves has been proposed in [15]. It parameterizes a curve using the B-spline model and adds a spread spectrum sequence to the coordinates of the B-spline control points. It is robust against various attacks, such as collusion, cropping, geometric transformations, vector/raster (raster/vector) conversions, printing-and-scanning and some of their combinations. But it requires the original image for integrity verification, i.e., it is non-blind [16].

Jungyeop Kim in [17] used polygon vector feature to embed his watermark in interior angles where it has a weak point that he cannot extract watermarks if the interior angles are changed in our proposed method we use point vector feature to embed our watermark and it was robust for versus attack as translation, rotation and scaling. There is a big challenge to protect the vector map from illegal copyrights and from attacks that can destroy the benefit of the map by changing places and coordinates on it. This will lead to a great loss in confidential data and cost to be reconstructed. This paper presents a blind watermark approach that achieves the authentication in 2D vector map.

The rest of the paper is organized as follows. Section 2 gives an overview of the features of 2D spatial data. Section 3 describes the proposed watermarking map authentication approach including insert and extract watermark processes. Also, the calculation of mapping cartesian to polar coordinates and using the support vector machine. Section 4 discuss different attacks including rotation, translation and scaling. Section 5 presents the experimental result. Section 6 addresses conclusions and future work.