

Dual Watermarking of Medical Images with Private Patient Information Based on Contourlet Transform

Farhad Rahimi¹, Hossein Rabbani PhD², Saeed Kermani PhD³

Abstract

Background: Advances in information and communication technologies and quick growth in using the Internet on one hand, and changing of medical equipment from analog to digital as well as modified appearance of modern healthcare system, on the other, cause more attention to telemedicine in health care centers. The transmission and storage of medical images in health care centers has a standard file format (DICOM). Since data is exchanged between these centers via ordinary commercial information transmitting channels like the Internet, new problems like issuance of patient information or malicious modification can occur. Watermarking is one of the new techniques used to solve this problem. Digital watermarking can imperceptibly embed patient information without changing image size or format. Watermarking has various techniques, but blind method and transform-based techniques are more popular.

Methods: In this research, we introduced a new blind contourlet-based watermarking technique. Images were divided into a region of interest (ROI) and a region of non-interest (RONI) and dual watermarking was used. After applying contourlet transform, the blocks were formed using coefficients of low level subband. For storing one bit in a selected block, the average of coefficients of each block was quantized to odd or even and appropriate procedures were used.

Findings: Different techniques such as peak signal-to-noise ratio (PSNR), bit error rate (BER), and structural similarity index measure (SSIM) demonstrated the efficiency of the proposed method.

Keywords: Watermarking, Transform domain, Contourlet transform

¹ Department of Biomedical Engineering, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran

² Assistant Professor, Department of Biomedical Engineering, School of Medicine AND Medical Image and Signal Processing Research Center, Isfahan University of Medical Sciences, Isfahan, Iran

³ Assistant Professor, Department of Biomedical Engineering, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran

Corresponding Author: Hossein Rabbani PhD, Email: h_rabbani@med.mui.ac.ir