UNIVERSITA' DEGLI STUDI DI SALERNO

DIPARTIMENTO DI INFORMATICA

XIII CICLO – NUOVA SERIE

ANNO ACCADEMICO 2013-2014

-Abstract-

TESI DI DOTTORATO IN INFORMATICA

Compression and Protection of Multidimensional Data

Tutor
prof. **Bruno Carpentieri**

Candidato
Raffaele Pizzolante

Coordinatore
prof. **Giuseppe Persiano**

Abstract

The main objective of this thesis is to explore and discuss novel techniques related to the compression and protection of multidimensional data (i.e., 3-D medical images, hyperspectral images, 3-D microscopy images and 5-D functional Magnetic Resonance Images).

First, we outline a lossless compression scheme based on the predictive model, denoted as *Medical Images Lossless Compression* algorithm (*MILC*). MILC is characterized to provide a good trade-off between the compression performances and reduced usage of the hardware resources. Since in the medical and medical-related fields, the execution speed of an algorithm, could be a "critical" parameter, we investigate the parallelization of the compression strategy of the MILC algorithm, which is denoted as *Parallel MILC*. Parallel MILC can be executed on heterogeneous devices (i.e., CPUs, GPUs, etc.) and provides significant results in terms of speedup with respect to the MILC.

This is followed by the important aspects related to the protection of two sensitive typologies of multidimensional data: 3-D medical images and 3-D microscopy images. Regarding the protection of 3-D medical images, we outline a novel hybrid approach, which allows for the efficient compression of 3-D medical images as well as the embedding of a *digital watermark*, at the same time. In relation to the protection of 3-D microscopy images, the simultaneous embedding of two watermarks is explained. It should be noted that 3-D microscopy images are often used in delicate tasks (i.e., *forensic analysis*, etc.).

Subsequently, we review a novel predictive structure that is appropriate for the lossless compression of different typologies of multidimensional data. We performed our experiments on different datasets of 3-D medical images,

hyperspectral images and 5-D fMRI images, which are publicly available. The experimental results show that our approach obtains results comparable with other state-of-art approaches.