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Different Methods for Image Processing and Dataset Retrieval Derived by the IPTM Group in Belgrade

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Abstract:

Lecture 1. Indexing and Retrieving of Large Image Datasets

Due to new technologies a huge digital multimedia files for personal, entertainment, professional and commercial use circulate over the Internet. Surprisingly, a growth of available information produces an opposite effect: more-files-less-benefits. How to find relevant information into the ocean of available data?

Retrieving of images may be performed indirectly – based on textual annotation and then searching for documents labelled by particular key words. Although such a technique may be very efficient and can be even automated, it suffers from several major drawbacks, especially when working with large databases. First, the process of manual annotating of database is extremely time-consuming and subjective: different users may annotate images in different way. Furthermore, the annotation is not unified, and additional problems are linguistic limitations. There is a need for precise description when annotating, and finding right combination of keywords when retrieving. Very often text descriptors are incomplete causing hard mismatches between user's needs and retrieving results – the problem known as the semantic gap.

Second approach is a content-based image retrieval (CBIR). In CBIR technique the low-level image features, such as color, texture, shape, etc., are extracted from images and arrange in some predetermined way forming an appropriate feature vector (FV). Retrieving procedure is based on relatively simple proximity measure between FVs to quantitatively evaluate the closeness (i.e., the similarity) between a query image and images from database. Results are promising but there is hard problem to express image context (subjective perception) by image content (objective measures). The retrieving accuracy can be significantly improved by introducing the user as a part of the retrieval loop. Starting with a query image, system selects initial set of images from database, objectively more close to a query, and presents them to a user though appropriate graphic user interface (GUI). From this set the user selects subjectively best-matched samples and annotates them in appropriate way. Feature vectors of annotated samples refine the searching procedure, according to subjective perception of visual content. Such a procedure, usually called relevance feedback (RF), is a way to effectively bridge the gap between the low-level image features and the high-level human perception.

Different CBIR techniques will be discussed and some results derived by the group from Image Processing, Telemedicine and Multimedia Laboratory, University of Belgrade will be presented.

Lecture 2. Application of Multifractal Analysis in Signal and Image Processing

Fractal geometry and multifractal analysis are very effective tools for describing and evaluating different complex phenomena. The fractal dimension is a good tool for characterizing the irregularity of natural objects and phenomena – for instance, classical problem of coastline description. However, if the phenomenon is more complex (such as, meteorological signals, radiology images, etc.) its characterization requires more general descriptors. The fractal dimension of such structures varies with the observed scale, and we can determine the distribution of fractal dimension, which is referred as multifractal. From multifractal spectrum more information can be extracted from given signals which describes complex structure. The signal can be analyzed both in local and global sence and even from an original signal ist parts characterized by particular multifractal values can be extracted, after applying the Inverse Multifractal Analysis.

After the brief review of fractal and multifractal analysis, some results derived by the group from Image Processing, Telemedicine and Multimedia Laboratory, University of Belgrade will be presented.

Lecture 3. Innovation Center of the Faculty of Electrical Engineering University of Belgrade: the Bridge between Academic and Industrial Institutions

The Innovation Center of the Faculty (School) of Electrical Engineering (ICEF), University of Belgrade, was established in 2006, as an independent R&D organization where scientific results are applied in a systematic and original way, as well as modern technological processes in order to create innovations, new products, technologies, processes and services or to alter already existing ones to follow the needs of the market.

The ICEF offers adequate facilities and working conditions to postgraduates and to the employees, working on different innovation projects for both international and domestic customers. Talented postgraduates are allowed to express in full their creativity and provide for their existence, without having to work in various commercial companies or leave the country. This is very important having in mind the development of information technologies (including telecommunications, automatics, electronics and other areas) as well as the strategy of technological development of Serbia. In this way it is possible to directly monitor and implement contemporary achievements in this area.

Bio: Branimir D. Reljin received the Dipl. Ing (B.Sc.) degree in 1969, the M.Sc. degree in 1977, and the Ph.D. degree in 1983, all from the Faculty of Electrical Engineering (FEE), University of Belgrade, Serbia and Montenegro (former Yugoslavia), in the field of Circuit Theory and Network Synthesis.

Since 1974 he is with the FEE where he is the Professor and since 2010 he is the Director of the Innovation Center of the FEE (ICEF). He is teaching different courses in graduate and undergraduate studies in Belgrade but also in other university centers: University of Novi Sad and in Čačak (University of Kragujevac), Sertbia, and at the Faculty of EE, University of Banja Luka (Republic of Srpska, Bosnia and Herzegovina).

He published more than 400 papers in journals and conference proceedings, as well as five textbooks, on different aspect of circuit theory, neural networks, digital image processing, fractal- and multifractal analyses. He has been awarded twice for the best paper at the largest national (former Yugoslav) scientific conference of the Society of Electronics, Telecommunications, Computer Engineering, Automation and Nuclear Engineering (ETRAN).

Professor Reljin is a member of the editorial boards of several journals and was the founder, organizer and General Chair of the IEEE supported conferences on neural networks, NEUREL (from 1995). He is a member of a number of scientific and professional societies, among others of the national society of ETRAN (he was elected vice-president in 2002-2006), the IEEE (where he is a Senior Member), and the Corresponding Member of the Academy of Engineering Sciences of Serbia.