Identification of area of articular cartilage using segmentation methods

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***Abstract*— A complex and highly stressed joint of the human body is its knee. It consists of a thick hyaline spongy maerial called articular cartilage between the tibia and femur bones. The imaging device is used which provides Magnetic Resonance Imaging (MRI) to image the joints because of its efficient result. The decrease in the thickness of the articular cartilage causes a disease called osteoarthritis also called as OA. Patients suffering from these disease faces alot of problems in their daily life as decrease in the motion in joints. It leaves the bones to rub against each other and it happens due to wear and tear movement. The synovial fluid does not provide proper lubrication , which leads to pain and restriction of movements at the joints. For this MRI images are widely used for diagnosis of joints with high resolution and flat suppression.**

But still images processing techniques are needed for better visual and wide variety of algorithms are available such as pixel and model based. But based on human expectation, segmentation has three forms as automated functions..

***Index Terms*— MRI, osteoarterities, segmentation, methods .**

I. Introduction

The articular cartilage is a highly specialized tissue, whose functions consist of distributing the joint load over a wider area of the bones and allowing movement of the opposite joint surfaces with minimal friction and wear. According to [1], articular cartilage is a viscoelastic material with two distinct phases: a solid phase (the organic extracellular matrix) and a movable fluid phase (the interstitial water with inorganic salts dissolved in it). The task of measuring articular cartilage in vivo has been greatly eased by recent developments in 3D Magnetic Resonance (MR) imaging. To date, MR allows for visualization of the main joint components, such as bones, cartilages, meniscii and ligaments and the changes that occur in them [2].

It provides full threedimensional (3D) view of the volume of interest, which makes it extremely suitable for imaging anatomical structures. Advances in MR imaging have led to improved resolution and contrast, allowing researchers to observe pathological changes in the joint's structures. Consequently, attempts have been made for assessment of cartilage thickness and volume from MR images [3]. Other studies concentrate on modeling the deformational behavior of articular cartilage after physical activity [4] from measurements performed on MR scans.

Magnetic Resonance Imaging

Magnetic Resonance (MR) is an imaging technique used mainly in medicine to produce high quality scans of the inside of the human body. It is based on the principles of nuclear magnetic resonance (NMR), i.e. the magnetic resonance of the atomic nucleus. The NMR phenomenon was discovered independently in 1946 by Felix Bloch and Ed. Purcell, nobel prize winner in 1952. In 1973, Paul Lauterbur first demonstrated the MR imaging principle using small test tube samples [5]. In 1975, Richard Ernst proposed magnetic resonance imaging using phase and frequency encoding, and the Fourier Transform [6]. Edelstein and coworkers demonstrated imaging of the body using Ernst's technique in 1980. At that time, the acquisition time for a single image was approximately five minutes. By 1986, the imaging time was reduced to about five seconds, without much loss in image quality. In 1991, Richard Ernst received the Nobel Prize in Chemistry for achievements in pulsed Fourier Transform NMR and MRI. In 2003, Paul Lauterbur and Sir Peter Mansfield were awarded the Nobel Prize in Medicine for their discoveries in MRI. The principle of nuclear magnetic resonance uses the fundamental property of atomic particles called spin. Spin comes in multiples of 1/2 and can be positive or negative. Individual unpaired electrons, protons and neutrons posses a (positive or negative) spin of 1/2. Two or more particles with spins having opposite signs can pair up to eliminate the observable manifestations of spin. Consequently, in MRI, the atoms of interest are those that have unpaired nuclear spins. Although almost every chemical element has an isotope that exhibits this property, the most abundant in natural state is the atom of hydrogen. Furthermore, the human body is composed mainly of fat and water, which contain many hydrogen atoms. This makes the human body approximately 63% hydrogen atoms. Thus, hydrogen is the principal element of interest in MR imaging. Other chemical elements that can be used for MRI include: oxygen, carbon, nitrogen, sodium, phosphor, potassium, etc. The standard MR variables that are measured in today's clinical applications are related to the distribution density and the two spin relaxation times T1 (spin-grid relaxation) and T2 (spin-spin relaxation) of the hydrogen nuclei in the tissue. Roughly speaking, the relaxation times express the time necessary to change the longitudinal (T1) or transversal (T2) components of the magnetization vector M induced by the oriented spins by a factor of e (i.e. the base of the natural logarithm).

II. LITERATURE

An image of any anatomical part of the human body must be interpreted by a medical expert. It includes some steps , as the first step in the interpretation process consists in identifying the physical objects depicted in the image and is known as segmentation. In the case of medical imaging, the objects are anatomical structures such as bones, ligaments, cartilages. The segmentation technique has its two basic methods: pixel and geometry-based :

Manuscript received March 30, 2015.

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A. *Pixel based method:* It implements the basic concepts of segmentation defined by [7] , it combines the adjacent pixels with similar image into the regions called segments.

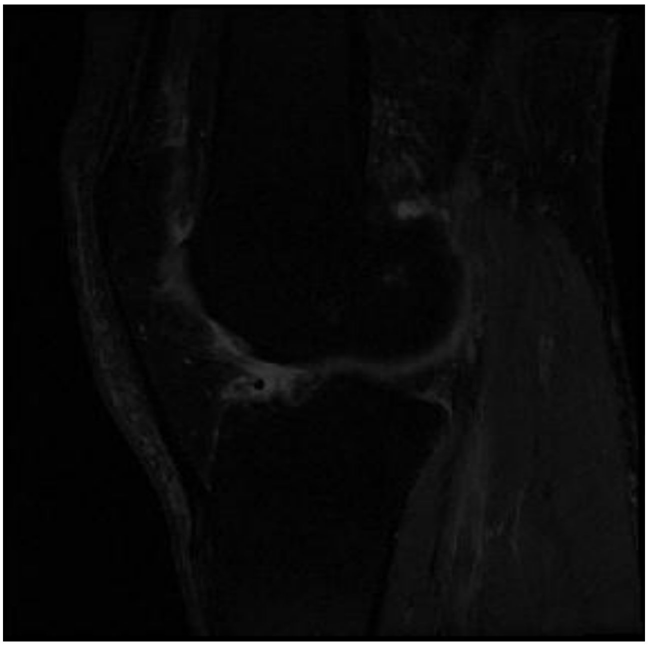
B. *Geometry based method*: segmentation is complementary to the pixel-based segmentation, in the sense that it employs a top-down technique for classifying image pixels. Such methods have found in recent years widespread use in computer vision and medical imaging. The values of the shape parameters can be computed by optimization of a goal function that characterizes the match between the selected image features and the expected ones. In general, the previously described pixel-based techniques are employed for estimating the required image characteristics. Since the object models are deformed during the matching process, this category of methods is also known as deformable models. The best known representative of this class of segmentation algorithms is probably the "Snake" algorithm, first introduced by [8]. In this approach, a 2D contour, called snake, is deformed in order to minimize its overall energy, which is composed from internal and external energy. The external energy depends on the image characteristics and attracts the snake towards the significant image locations (usually edges) while the internal energy depends on the shape of the snake and has a regularization effect. The "Snake" framework can be extended to 3D in a straightforward manner. By imposing geometric constraints to the segmentation process, "Snake"-like methods can handle image regions with missing information. This comes, of course, with a loss of generality, as information about the shape of the object to be segmented must be known in advance. However, there is a large majority of cases in medical imaging for which geometry-based techniques are required. Moreover, in many situations, a simple deformable model is not enough, as it might lead to illegal shape instances, i.e. shapes that are outside the natural range of variability of the given anatomical structure. For these cases, additional constraints on the object's shape must be enforced, leading to even more specialized methods. Probably the best known class of such methods uses statistical models to control how the object model deforms during the segmentation process. Statistical models are built from a large number of instances of the same object in order to capture its variations within the population. During segmentation, the model is constrained to remain in the shape sub-space calculated from the population statistics.

III. DISCUSSION

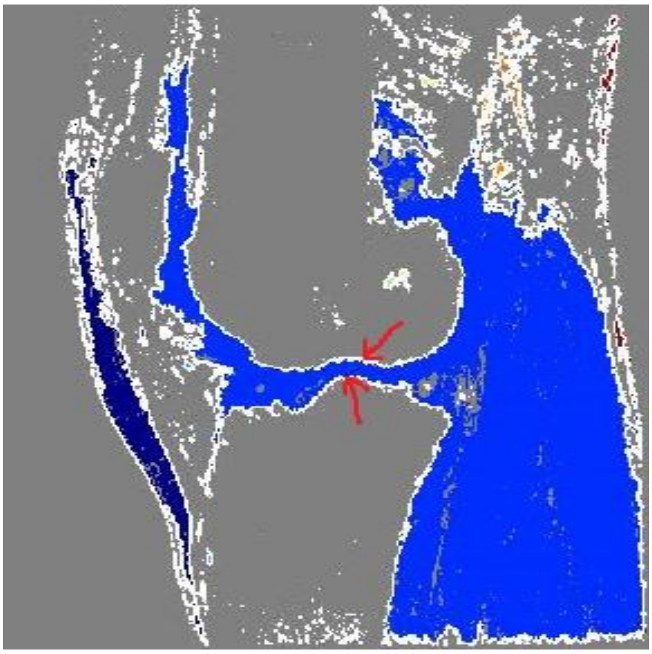
The semi- automatic cartilage segmentation works for the development of an automatized method for segmentation of the patellar cartilage the development of the semi-automatic segmentation tools allowed the author to better understand the characteristics of MR images of the knee joint. Also, the main problems that occur during patellar cartilage segmentation could be identified. Part of the semi-automatic tools were also ported to the program that implements the automatized method for patellar cartilage segmentation. Consequently, they can be used to correct the segmentation results as well as for performing interactive delineation of any structure present in the MR data volume (e.g. the femur, tibia and patella as well as their cartilages). This program was named "Automatized Cartilage Segment" and shall be referred to as "ACS" the semi-automatic segmentation tool implemented in the stand-alone application named "Segment 2002".

IV. RESULTS

Here, we are using segmentation methods to extract the area of the cartilage i.e., cartilage segmentation. It gives the result in the form of colorful area by which we can extract the region of it which is to be performed for further process. Some of the segmentation process are listed above which plays important role to detect the image from its original value. The images taken below are in the form of (a) which is an original image and (b) which is the segmented image.



(a)original image



(b) segmented image

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