(4) أدبيات البحث
Literature Review

يُذكر فيها ما يلي:

1- نبذة عن موضوع البحث وأهميته.

2- الدراسات السابقة وأحدث ما توصلت إليه المعرفة في مجال البحث

Medical image processing is a computing process of object recognition in medical image using computer vision, applied mathematics, signal analysis and artificial intelligence. Structures from medical images is the first step in many image analysis applications developed for medical diagnosis. Depending on the fact that diseases affect specific tissues or structures, lead to loss, atrophy (volume loss), and abnormalities. Consequently, an accurate, reliable, and automatic image understanding of these tissues and structures can improve diagnosis and treatment of diseases. The main operations in this case are filtering, segmentation and edge detection. Manual medical image understanding, although prone to rater drift and bias, is usually accurate but is impractical for large datasets because it is tedious and time consuming. Automatic medical image processing can be useful for clinical applications if they have: 1) excellent performance for diverse datasets; and 2) reasonable processing speed.

An important problem of medical image processing is the extraction of relevant features against a complex background. Such a problem may be considered also as a problem of local image enhancement or specific anti-filtering. Removal of noise is usually a low-pass filtering: reduction of the high or medium frequencies corresponding to the noise, and preservation of the low and non-interfering medium frequencies. Assume that an image is given, that is noise free, but it is not sharp; even more it may be smoothed. The goal is to restore boundaries of objects and extract features. The objective of this project is to be able to extract the core features which are able to classify the tissue and structure considered by the medical images. Moreover, to learn a system's behavior from representative examples and the ability of Reinforcement algorithms to optimize complex systems, particularly when no mathematical model is available.

So far the problem of medical image processing has been handled by many different researches; Artificial Neural Networks (ANNs) have been developed for a wide range of applications such as function approximation, feature extraction, optimization, and classification. In particular, they have been developed for image enhancement, segmentation, registration, feature extraction, and object recognition. Among these, image segmentation is more important as it is a critical step for high-level processing such as object recognition. Multi-Layer Perceptron (MLP), Radial Basis Function (RBF), Hopfield, Cellular, and Pulse-Coupled neural networks have been used for image segmentation. These networks can be categorized into feed-forward (associative) and feedback (auto-associative) networks. MLP, Self-Organized Map (SOM), and RBF neural networks belong to the feed-forward networks while Hopfield, Cellular, and Pulse-Coupled neural networks belong to the feedback networks.
Unfortunately, ANN is still suffering from some problems, proneness to over-fitting, and the empirical nature of model development. Furthermore, Some methods process medical images by its texture and boundary shape which is modeled by a probability distribution function. These methods like the Compression based method, histogram based method, region growing method and spilt and merge method have been used for medical image processing. Histogram based method is the most efficient method of all, but it can't handle the problem of spatial evolving, subjective structure that changes during time.

Although these methods achieved high ability, the spatial changes that may happen during disease evolution has not been handled yet. Hence, a new technique that is evolved by time and based upon the spatial arrangement should be appeared. Also, a heuristic model that learn from series of real data and optimize the learning process should be used. In this project, cellular neural network algorithm and reinforcement optimization techniques are integrated to show analyze how the image segmentation and filtering are performed.
Since Cellular Neural Networks, CNN is a hybrid of Cellular Automata and Neural Networks and incorporates the best features of both concepts, then; the learning mechanisms in Cellular Neural Networks are usually associated with the changes in synaptic efficiency. In such a model, a synaptic learning rule controls the variation of the parameters (the feedback cloning template, the synaptic weight, and the threshold) of the CNN. Researches in CNN have proposed learning methods based on mathematical principles, but better learning rules may be

needed to achieve human-like performance for many learning problems. The main problems that the CNN's supervised learning suffers from; it's extremely slowness, the training performance is sensitive to the initial conditions, it may be trapped into a local minima before converging to a solution, oscillation may occur during the learning phase (This is usually happened when the learning rate is high), and if the error function is shallow, the gradient will be very small leading to small weight changes. Coupled to this, Cellular neural networks, CNN, consists of an array of simple processing elements locally interconnected. This characteristic makes them very well suited for medical image processing. Moreover, their massive parallel processing capabilities makes CNN a very interesting choice for those applications requiring high processing speed. A goal of this project is to find new supervised learning rules that take into account hardware implementation constraints using Reinforcement optimization technique, such as Parallel Genetic Programming. GP is a learning method based on the natural theory of evolution and the flow of its algorithm is similar to the Genetic Algorithms. This method considers the learning rules of the CNN as three parametric functions associated with the inputs and the outputs, whose values vary for each synapse, and a fixed number of parameters, which are the same for all synapses in the CNN. Since CNN has different structure, uncoupled, coupled and autonomous, thus each CNN architecture should be treated as a subsystems. Moreover, all subsystems should corporate and migrate their best individual, supervised learning rules, among them though time phases. This is called reinforcement optimization and represented by parallelism. Parallelism refers to many processors, with distributed operational load. Each GP is a good candidate for parallelization. Processor may independently work with different sub-systems of a search space and evolve new generations in parallel. This helps to find out the optimum solution for the complex problems by searching massive populations and increases quality of the solutions by overcoming premature convergence, local minima, and population diversity.

One of the most ingenious taxonomies is the Parallel Island Model (PIM), where the population is divided into a few large subpopulations and these subpopulations are maintained by different processors. Processors are globally controlled by message passing within Master-Slave architecture. Master processor sends "START" signal to the slave processors to start generations and continue sending "MIGRATION" message to partially exchange the best trees, supervised learning rules, among processors. Thus, the worst individual in each sub-population is replaced by the best received ones. Time between two consecutive MIGRATION signals is called the migration step; percentage of the best individual is called migration percentage. Migrations should occur after a time period long enough for allowing development of good characteristics in each subpopulation. The migration can be implemented as synchronous and asynchronous. In synchronous migration, all nodes proceed at their own rates and synchronize when the migration occurs. The problem of synchronous migration is that it can cause uneven workloads among processors due to the different rate of evolution. In asynchronous migration, the migration occurs without relating to the state of all processors. Asynchronous migration can reduce the wait time required for all processors.

By this project, Parallel Genetic Programming is overcoming some of the learning problems and guarantee correct operation of analog VLSI chips by means of the introduction of multi-objective fitness function. This strategy has the side effect of reducing the computational cost of the optimization process since it focuses on those areas of the search space that meets the implementation requirements. New learning rules have been discovered and compared with analytical one though medical image applications. This study indicates that there exists admissible supervised learning algorithm better than, but similar to, the supervised learning and that PGP can be used to discover it.