IVUS IMAGE CATEGORIZATION USING STOCHASTIC GRADIENT DESCENT ALGORITHM

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Abstract:

In IVUS, not only the lumen of the coronary arteries can be correctly shown but also the atheroma hide within the wall. In clinical research, IVUS has thus allowed progress to be made to provide a more comprehensive perspective and understanding. The cardiovascular arteries are the most common IVUS imagery target. IVUS is used to assess the quantity for atheromatous plaque in the coronary artery at any particular level. In IVUS, regression progress is a special approach for learning. The IVUS image classification using Stochastic Gradient Descent (SGD) algorithm is described in this study. The IVUS images are given to frequency domain for feature extraction and SGD algorithm is used for detection. Experimental results show the performance of proposed system.

Keywords: IVUS classification, Stochastic gradient descent algorithm, IVUS images

Introduction:

Automatic classification and distinguish of IVUS and texture characteristics of atherosclerotic lesions in swines [1]. Texture steps have been used to minimize measurements, followed by a main component analysis. The research dataset was evaluated by two independent experts and the findings were compared. Genetic, IVUS tissue characterisation systems rule-based classification schemes [2]. Increase class discrimination, a rich variety of textural features are available on different scales including statistics from the first order, matrix co-occurrence of gray rates, runlengths, waves, local binary patterns.

IVUS-based atherosclerotic plaque characterisation with feature selection and SVM classification [3]. The features are determined using multiple window sizes to change the values of the different patterns in the region. Classification of diseases using the determination of artery cross section layers, which is the adventiveness, media, and lumen layer [4]. A computerized ultrasound is connected to the proximal end of the catheter.

Automated coronary stent identification in IVUS pictures by using the classification cascade [5]. Cascade of GentleBoost classifiers for stent struts to identify the separate subregions of strutes with structural features. Automatic identification in IVUS image using a

Cascade of Classification Stents [6]. GentleBoost Cascade for identification of stent struts with structural characteristics to code the detail in the various sub-regions of struts [7]. In order to prevent noise, IVUS images are fitted with a freeze filter. generated by ultrasound waves in the imaging technology [8].

Intravascular ultrasound image categorization using belief networks for the detection of abnormality in vessels is described. Section 2 describes the methods and materials used for IVUS image classification. Section 3 describes the experimental result and discussion. The last section concludes the IVUS image classification.

Methods and Materials

Initially, the input images are given to frequency domain features and Stochastic gradient descent algorithm is used for prediction.

Frequency domain features

The simple mathematical analysis is one of the key reasons to use the frequency-domain representation of a problem. Moreover a frequency system can usually give an intuitive understanding of the system's qualitative behaviour; a scientific nomenclature that reveals the behavior of physical systems, which characterizes inputs from time to time by different terms like the definition was created for bandwidth, frequency response, gain, phase change, resonant frequency.. A given function or signal can be translated to a pair of transformed mathematical operators between the time and frequency domains [9]. The reverse transform of Fourier returns the time feature frequency-dominal. A spectrum analyser is a frequency-domain device widely used to represent optical signals.

Stochastic gradient descent algorithm

A compromise between the real gradient and the gradient is to calculate the gradient against more than one sample of training at a single point. That can function much better than the originally defined stochastic gradients, as the code can use vector libraries instead of computing individual steps. Gradient descent is a easy method of optimization you can use with several computer algorithms. The gradient optimization can be viewed as a stochastic strategy, since it substitutes the real gradient by an approximation. For traditional statistics, for lesser squares and in maximum-like independent observations, sum-minimization difficulties are noticed. M-estimators are called the general class of estimators that emerge as a sum minimizer. Figure 1 Stochastic gradient descent algorithm.
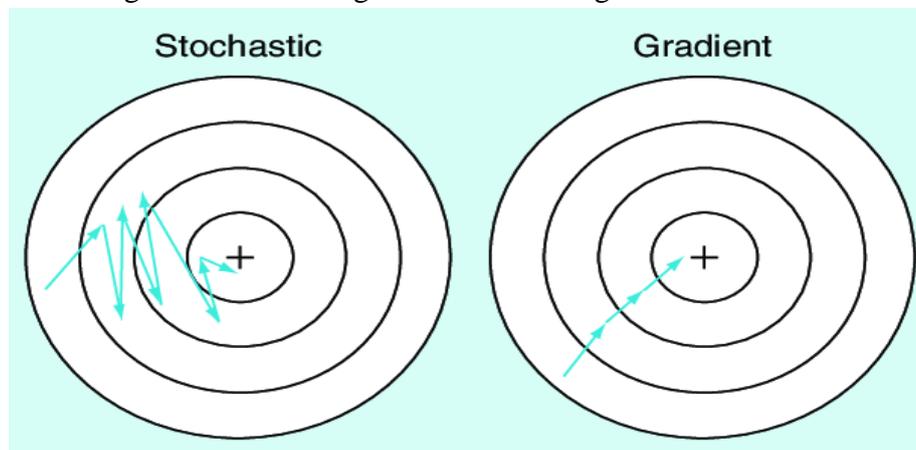

Figure 1 Stochastic gradient descent algorithm

The downturn of the stochastic gradient will converge faster as updates are performed more often. Furthermore, instead of training on single datasets, the inventory of online/minibatch training uses vectorised operations and process the mini-batch at once. Gradient Descent is a differentiable functions local optimization algorithm. Gradient descent is simply used to find the parameter values of a function which minimise cost.

Results and Discussion:

The performance is evaluated by using IVUS images. The performance of stochastic gradient descent algorithm for IVUS image classification using frequency domain features of retinal images is measured by classification accuracy. Table 1 shows the classification accuracy of IVUS images for prediction.

Frequency domain feature levels	Performance (%)		
	Accuracy	Sensitivity	Specificity
1	88	89	87
2	86	87	85
3	90	91	89

From table 1 it is observed that classification accuracy is 90% and its sensitivity and specificity are 89% and 91% at level 3 by using SGD algorithm.

Conclusion:

An efficient method for SGD algorithm for IVUS detection using IVUS images is described in this study. The input IVUS images are given to frequency domain features for feature extraction. Then SGD algorithm is used for classification. The overall classification accuracy is 90% and its sensitivity and specificity are 91% and 89% by using frequency domain features and stochastic gradient descent algorithm.

Reference:

[1]   Brathwaite, P., Nagaraj, A., Kane, B., McPherson, D. D., & Dove, E. L. (2002, September). Automatic classification and differentiation of atherosclerotic lesions in swine using IVUS and texture features. In Computers in Cardiology (pp. 109-112). IEEE.

[2]   Giannoglou, V. G., Stavrakoudis, D. G., &Theocharis, J. B. (2012, November). IVUS-based characterization of atherosclerotic plaques using feature selection and SVM classification. In 2012 IEEE 12th International Conference on Bioinformatics & Bioengineering (BIBE) (pp. 715-720). IEEE.

[3]   Sridevi, S., &Sundaresan, M. (2019, March). Evaluation of Classification Techniques for IVUS Images. In 2019 6th International Conference on Computing for Sustainable Global Development (INDIACom) (pp. 998-1002). IEEE.

[4]   Rajan, A. (2018). Classification Of Intravascular Ultrasound Images Based On Non-Negative Matrix Factorization Features And Maximum Likelihood Classifier. International Journal Of Advances In Signal And Image Sciences, 4(1), 16-22.

[5]   Kumarapandian, S. (2018). Melanoma Classification Using Multiwavelet Transform and Support Vector Machine. International Journal of MC Square Scientific Research, 10(3), 01-07.

[6]   Narayanan, K. L., & Ramesh, G. P. (2017). Discrete Wavelet Transform Based Image Compression using Frequency Band Suppression and Throughput Enhancement. International Journal of MC Square Scientific Research, 9(2), 176-182.

[7]   A, Rajan. 2018. "Classification of Intravascular Ultrasound Images Based On Non-Negative Matrix Factorization Features And Maximum Likelihood Classifier", International Journal Of Advances In Signal And Image Sciences, 4 (1), 16-22.

[8]   J. Aswini, N. Malarvizhi, T. Kumanan , Department of CSE, Meenakshi Academic of Higher Education and Research, Chennai, India, International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-8 Issue-3, February 2019.

[9]   Vanithamani, R., Kumanan, T. Department of CSE, Meenakshi Academic of Higher Education and Research, Chennai, India, International Journal of Recent Technology and EngineeringVolume 8, Issue 2, July 2019, Pages 478-481.