

Abstract

Image quality is governed by many visual characteristics of the image for example, brightness, contrast, color distribution, presence of noise, etc. Alteration in those characteristics can cause noticeable perceptual changes of image appearance to human viewer. In several cases degraded images are resulted due to diverse reasons like low illumination, noise in capturing device, wrong color interpretation, etc. Addressing each of such degradation is wide research area. Image contrast enhancement is a frequent image enhancement requirement in diverse applications.

There are many conventional techniques to approach different low contrast in image including filter development, kernel processing, and image transformations in different domains. Those classical approaches can result contrast enhancement however, often their applications found to be limited due to high processing time, computationally expensive and not adaptable in nature or in other medium such as satellite, underwater etc. Many of the times the classical technique involve lots of parameters and tuning of the parameters itself become difficult. These techniques are also suffer from problems like over enhancement, whitening of the image, non preservation of image brightness, false contouring, etc. Another important limitation of conventional techniques has been observed that many such techniques improve the image contrast without maintaining other image characteristics which also gives an artificial appearance to the enhanced images.

Recently computational intelligence (CI) has become a popular tool in image enhancement domain to address limitations resulted by the conventional techniques. The CI algorithms

due to their adoptability, flexibility and optimality can result contrast enhanced images which are improved both in terms of visual and objective assessment. In a general note CI algorithms mimic the natural behavior in biological agents to search optimal solution of the problem. For example, artificial bee colony (ABC) mimics the food searching algorithm of honey bees while grey wolf optimizer (GWO) algorithm is motivated by hunting behavior of grey wolf. The development of CI algorithms is continuing which leaves a considerable room to apply those algorithms in image contrast enhancement tasks.

This work is aimed to explore the possibilities of employing CI algorithms to address image contrast enhancement task while maintaining the other image characteristics like brightness, color, sharpness, etc. Two objective functions based on contrast interpretation and imaging model have been developed to enhance the image contrast and retain the other image characteristics. The fitness function is formulated using different image quality assessment (IQA) metrics. Three advanced CI algorithms i.e. bacteria colony optimization (BCO), grey wolf optimizer (GWO) and bat algorithm (BA) have been consider for this purpose due to their several advantages over other CI algorithms. Both gray scale and color images have been taken from standard databases to vouch the potential of presented techniques. The resulted images have been compared with the results of conventional techniques and other CI algorithms for the image contrast enhancement task under consideration both visually and objectively.