

Image Quality Extension

**AUTOMATICALLY ASSESS THE QUALITY
OF AN IMAGE BASED UPON REPRESENTATIVE
IMAGES MANUALLY GRADED BY EXPERTS**

The Image Quality Extension (IQE) is a member of the Aphelion™ Imaging Software Suite of image processing and analysis tools. It provides a methodology for automatically assessing the quality of digital images, stored locally or remotely.

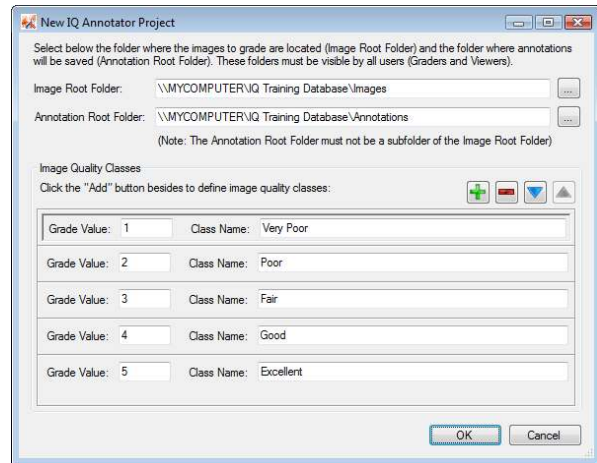
The quality of an image is very subjective since it highly depends on one's perception of that image. It also depends on the ultimate goal for the use of the image in a specific application. Interpreting an image is different between two persons, who might have a different way to look at the image, a different way in mind to analyze the content of the image, and already thought about the type of analysis and interpretation they want to perform on the image.

For example, an ophthalmologist looking at a retinal image may rate the image's quality as very good for lesion detection, while a non-retinal specialist may consider the image quality as poor since he/she does not know how to identify the lesions.

IQE helps remove the subjectivity factor. Continuing with the retinal images example, the IQE process begins with ophthalmology experts manually grading a set of training images, assigning each to a specific class. In this example, there are five classes that characterize the visual quality of the image ranging from *very poor* to *excellent*.

Next, and staying with the retinal image example, IQE generates a classifier which is used to automatically grade new retinal images. IQE contains a rich set of image descriptors, also called measurements (e.g., area, perimeter, texture, contrast). Associated with each descriptor is an algorithm that computes the value of that descriptor for each input image. IQE uses the training set of images and the grades assigned to each by the domain experts to determine which of the descriptors are the most relevant to accurately grade new retinal images.

Please note that while the above explanation used the domain of retinal images, IQE is wholly general and can be used for any domain of images.



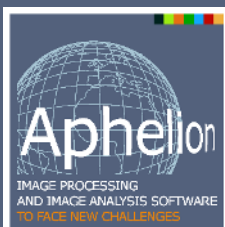
For example, the IQ Annotator component included in IQE (see above graphic) enables the user to redefine the number of classes and their meanings, names, and numeric values.

IQE Process

The IQE process is comprised of three main components that correspond to the following three processing steps:

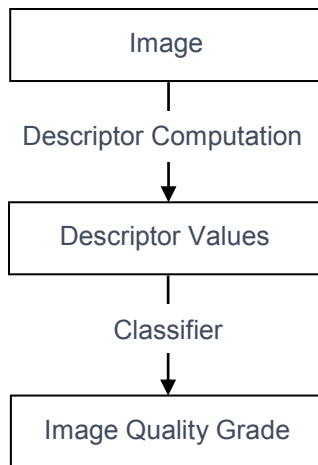
1. Annotator – Build a training database by having domain experts use IQE Annotator to manually grade a training set of representative images.
2. Classifier – Generate a classifier specific to the targeted image domain. This processing step automatically computes the values of image descriptors (measurements) that characterize features of the image (e.g., area, noise, illumination, texture, presence/absence of edges), and generates a classifier using IQE Classifier.
3. Evaluator – Evaluate a set of one or more new images from the targeted domain.

Standard descriptors are computed in IQE Classifier, but developers can add their own descriptors for their specific application.



Main benefits of Image Quality Extension:

- Automatically assign a quality grade to images based on expert knowledge
- Improve an image acquisition process by rejecting poor images
- No need to be an expert in image processing to build an IQ grading system
- IQE can be used for other applications where a manual grading is involved



Manual Image Annotation

With the IQE Annotator interface, the expert can simply assign a specific grade to an image that is displayed on the screen. Shortcuts are provided to make the manual grading process easy.



In addition, the content of the training database can be displayed as an array of thumbnail images. This enables a grader to perform an initial visual evaluation of the entire set of images to be graded.

Classifier Generation

After all images of the training database have been manually graded, IQE computes a set of descriptor values for each image in the training database. IQE's default set of descriptors are the 50 or more available in Aphelion Dev. Advanced users can adapt these default descriptors for their own application by modifying the descriptors and adding new descriptors.

The IQE uses the Random Forest classification method. During generation of the classifier, charts showing the generation progression are displayed in the user interface. Once the training process is completed, the resulting classifier is saved in a specific Aphelion format to be later used in IQE or other members of the Aphelion Imaging Software Suite.

Automatic Quality Evaluation

Once the classifier is generated, the user can evaluate one or a batch of images using the IQE Evaluator interface, as shown in the figure below. IQE helps imaging technicians capture images of sufficient quality to be effectively processed by automated systems. In addition, a warning can be generated to let the technician know an image has poor quality and needs to be recaptured. IQE also helps reduce the size of image databases by discarding low quality images that cannot be effectively analyzed.



Image Quality Deployment

The classifier generated by IQE Classifier can be embedded into the user's own application. IQE includes C# programming examples to aid the user with the embedding process. The examples provided are for applications that automate the grading of images based on the occurrence of domain specific features and events visually recognizable by domain experts.

