

Algorithms for Automatic Recognition of Non-informative Frames in Video Recordings of Bronchoscopic Procedures

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Abstract. The video recordings of endoscopic procedures performed within respiratory tract include both frames of adequate and inadequate quality for the assessment by the endoscopist. The frames of inadequate quality were called by some authors blurred or “non-informative”. The fraction of blurred frames within video recording of bronchofiberscopy may be considerable and it varies from case to case. Therefore, the function of automatic exclusion of “non-informative” frames would bring substantial benefits in terms of the volume of the archived video recordings of bronchofiberscopic procedures. Furthermore, it could also save the time of users accessing medical video library established with archived resources. In this paper, the authors have proposed, tested and compared several algorithms for detecting blurred video frames. The main focus of this paper is to compare various, independent algorithms for automatic recognition of “non-informative” frames in video recordings of bronchoscopic procedures. The results demonstrated in the paper show that the proposed methods achieve F-measure, sensitivity, specificity and accuracy of at least 87% or higher.

1 Introduction

Although medical image processing is one of the most rapidly growing fields of research, relatively low interest was assigned to endoscopic procedures. Research focused on the processing of images obtained during bronchofiberscopy has been

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particularly neglected. Furthermore, most of the systems enabling recording of bronchofiberscopic procedures do not offer more advanced functions of automatic image indexing or recognition.

The authors are involved in the project whose aim is to develop a computer system supporting management of video recordings created during routine bronchofiberscopic procedures performed on an every day basis in a bronchoscopy laboratory. The system is supposed to improve the work-flow within the laboratory by means of video recording, archiving, indexing of recorded videos as well as the automatic image recognition both with archived resources and in real-time during bronchofiberscopic procedures.

The video recordings of endoscopic procedures performed within respiratory tract include both frames of adequate and inadequate quality for the assessment by the endoscopist. The frames of inadequate quality were called by some authors blurred or “non-informative” (see Fig. 1). The fraction of blurred frames within standard video recording of bronchofiberscopy may be considerable and may vary from case to case. It is known that even 30% of frames within video recordings of colonoscopy (being a procedure visually similar to bronchofiberscopy) may be blurred. This fraction may be even higher in video recording of bronchofiberscopies as the occurrence of the factors which can impair endoscopic image quality is higher (relatively small diameter of the lumen of bronchi, frequent accumulation of mucous or pus in pathological cases, coughing and respiration movement overlapping with manipulations with bronchofiberscope) [1].

The “out-of-focus” frames make a considerable part of “non-informative” frames in video recording of bronchofiberscopy. It depends partially on the fact that the vision system of the endoscope usually includes only single wide-angle lens located

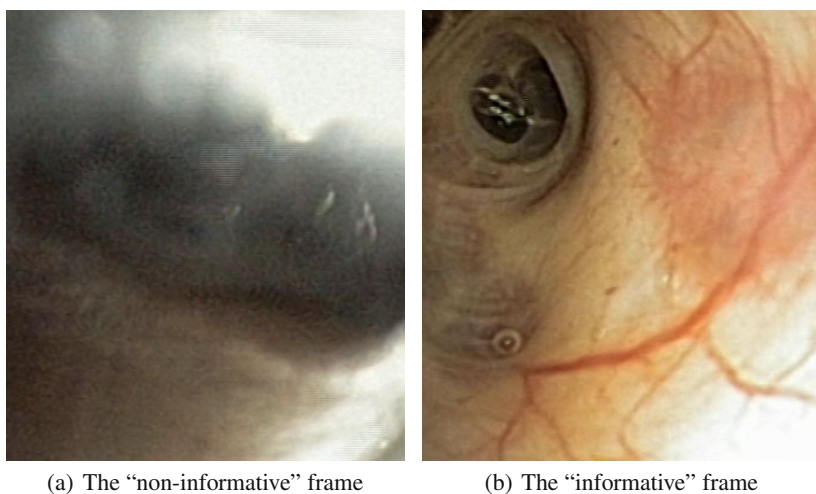


Fig. 1 Examples of the “non-informative” and “informative” frames