

**FATIGUE COUNTERMEASURE USING AUTOMATIC REAL-TIME  
VIDEO PROCESSING OF EYE CHARACTERISTICS**

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**Summary:** Fatigue is a large and growing problem for aviators and motor vehicle drivers. A fatigue countermeasure based on digital video processing of images of the subject's face has been developed. Digital video data of drivers was collected in experiments in a driving simulator at the University of Iowa. Algorithms were developed to automatically locate the head, eyes, and face features of the driver using wide field-of-view images. The exposed eye area is quantified using the final eye target location. Automatic processing of face features in a vehicle environment is a difficult task due to the complexity of the scene and the variable lighting conditions. The use of both static and dynamic processing in parallel and the use of symmetry has lead to the development of innovative and useful algorithms for automatic face location and feature detection. The prototype system was effective in automatic feature location for all 13 subjects tested in driving simulator studies. The appearance of visible eye features is quantified and used to determine onset of potentially dangerous fatigue conditions. An alarm event is generated if the eyes remain closed longer than 1.5 seconds, or if sustained reduction in area of exposed eye features is detected (eyelid droop). Other studies in the literature have validated correlation of measures of pupil occlusion (such as PERCLOS) with operator performance lapse. The system is designed to work with an inexpensive digital video sensor mounted on the dashboard of a vehicle and runs on standard computing hardware.