Manual process vs Automatic System

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<td>Real-time diagnosis</td>
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<td>Objective results</td>
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<td>No clinician needed</td>
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<td>Adaptable to telemedicine</td>
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References


Automatic Dry Eye Assessment

VARPA Group
University of A Coruña
GVA Group
University of Santiago de Compostela
Optometry Group
University of Santiago de Compostela

The Dry Eye Syndrome is a common disorder of the tear film, which affects a significant percentage of the population, especially among contact lenses users. Moreover, it worsens with age. The prevalence of this syndrome has been increasing in recent years, affecting up to 10-15% of normal population, and 18-30% of contact lenses users. Several factors, such as adverse environmental conditions, use of certain medications, or visual tasks that reduce blink rate, have contributed to that increment.

In the practice, there are several clinical tests to diagnose this syndrome by means of analyzing the tear film quality. In this sense, we have developed automatic solutions to provide an objective assessment of two of them: the measurement of the tear film Break Up Time and the analysis of the Interference Lipid Layer Patterns.
Break Up Time Test (BUT)

Time required for dry spots to appear on the corneal surface after blinking

- Sodium fluorescein dye is instilled in the eye
- The tear film is observed under a slit lamp
- The longer it takes, the more stable the tear film is
- Ruptures in the same locations could point out weak tear film areas
- Break up shape is an indicator of tear film stability

Solution

- Automatic location of measurement areas between consecutive blinks
- Automatic adjustment to different eye sizes and shapes
- Automatic measurement of BUT
- Automatic computation of rupture features
  - Location based on the CCLRU grid
  - Size or rupture area
  - Shape classification of ruptures into dot/line/pool patterns

Devices and videos

Our solutions were tested with 2 min videos (3 measurement areas per video, 1024x768 px, 15 FPS, MJPEG compression) acquired with a Topcon DV-3 camera attached to a Topcon SL-D4 slit lamp

Results

Detection of measurement areas
95 % correctly detected

BUT measurement
Mean difference of 1.26 s between system and mean of 4 experts.

Break-up patterns
85 % correctly classified

Interference Lipid Layer Patterns

Tear film lipid layer plays a major role in limiting evaporation and tear film stability

- Its quality and thickness can be analyzed by interferometry
- Tearscope-Plus is a hand-held instrument designed to view the tear film non-invasively
- Guillon proposed five main grades of lipid layer thickness interference patterns (open meshwork, wave, color fringe, and amorphous)

Results

Classification accuracy > 96%
Processing time < 1 second