



- Accurate modelling of eye behaviour
- Validation against representative lab tests
- Applications for implants
- Contact lens improvements

The University of Dundee has developed accurate predictive tools to model the eye's response to internal effects such as diseases, intraocular pressure and external effects such as sports impacts, laser surgery and contact lenses.

This improved understanding of eye behaviour will be of interest to companies in the areas of contact lens development and manufacture and tonometry instrumentation.

The Ocular Biomechanics Research Group has applied expertise in mathematical analysis and computer-based numerical modelling to improve understanding of the eye's behaviour and to create accurate predictive tools on how the eye responds to factors such as elevated internal eye pressure and external impacts.

The group can test corneal buttons and whole eye globes under controlled conditions to simulate real life conditions: specifically under both elevated internal pressure and external forces and impacts, within a temperature and humidity controlled environment.

Background

Numerical modelling work is based on using the finite element method to carry out non-linear analyses of ocular response problems. It is carried out using a highly reliable and flexible structural analysis and modelling package. The modelling accuracy is improved through:

- (1) the incorporation of realistic ocular topography, which is not purely spherical,
- (2) the use of reliable material property models describing the visco-elastic hyperelastic material response under both loading and unloading conditions

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(3) the adoption of 3D finite element constructions of shell and solid elements that can provide close idealisation of the ocular structure, including its layered composition.

In summary, the group's numerical simulations attempt to simulate real life conditions in order to improve accuracy and reliability of predictions.

Applications

The models have been successfully used to

- model the processes involved in contact and non-contact tonometry
- predict the ocular reaction to wearing contact lenses.
- estimate correction factors for contact and non-contact tonometry measurements.
- study the effect of intra ocular pressure elevation on damage to optic nervehead

Software

The modelling software developed by the group offers a high level of accuracy and speed, and can quickly produce numerical models relevant to a wide range of applications involving the biomechanical performance of the eye.

The models are close to real life conditions and have been validated against test results conducted in Dundee and elsewhere.

The Group has been able to provide assistance by carrying out numerical modelling tasks for partners in the health service and in industry and is planning to expand its capabilities in this area.

The University is interested in building relationships with companies especially in the area of cornea implants, contact lens developers and tonometry instrumentation.

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