

Vision Science III

Models of Oculomotor Control

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Eye movements are accurate reflections of brains control strategy.

- Bioengineering point of view may have difficulty understanding the visual system point of view.
- Non-engineers overwhelmed by complexity of biomedical applications of control theory.
- Many great discoveries have been made by the combining of these two outlooks:
 - ✓ Diagnostic tools for clinical testing ranging from autorefractors, tonometers, to automated visual field machines.
 - ✓ Guidelines for dysfunction in oculomotor systems
 - ✓ More clinically oriented often drives the research of the visual scientist.

Control system Analysis:

Method to analysis and explain ocular motility specifically:

Accommodation

Vergence
Saccades
Pursuits
VOR and OKN

Bock Diagram Model:

Terms:

Input: stimulus to drive the system

Accommodation: target distance in diopter

Saccade: Target position, angle in degrees

Pursuit: Target motion deg/sec

Vergence: Vergence stimulation from disparity

VOR/OKN: target velocity and Head Velocity

The various components of control are the blocks.

The plant is the controlled physical component that results in the output.....extraocular and intraocular muscles

Accommodation: change in focus

Saccade: change in angle of the eye...position

Pursuit: change in velocity of the eye

Vergence: change in position of the eyes

VOR: change in velocity of the eyes

Feed back control types of systems:

Open Loop system: none of the output is fed back to input

Closed Loop system: all or part of the output is fed back to the input altering the final output

Negative feed back.....

All or part of the output is subtracted from the input to give the error signal driving the controller. This gives a more stable system.

Positive feed back....

All or part of the output is added to the input to give error signal resulting in instability.

Dead Space; portion of operating range of a control element over which there is no change in output for a given input.

Normally the input is greater than threshold and a response occurs. But in the dead zone, a change in stimulus is noted but is too small to warrant correction.

For example: Saccades... target is to be in the foveal area, no movement response if the stimulus stays in this area.

Accommodation; depth of focus creates the dead zone.

Gain: The ratio of output to input magnitude. The response is equal to the stimulus. This is often very close to 1 in oculomotor systems. In a perfect world it would be exactly 1. By not being exactly 1, it allows for a system to operate more efficiently.

Such as accommodation can lag by DOF

Saccades can be off by foveal area

Vergence may be off by Panum's fusional area