Analogue Computer Model of Progressive Myopia-Refraction Stability Response to Reading Glasses

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Brief Communication

A tendency of the eye to become myopic with long hours focusing at a near distance has been reported often [1-8]. Myopia development, as any refractive development, is described by a first order feedback system. A first order feedback system is defined by its transfer function $F(s) = 1/(1+ks)$ [1,2]. This function anticipates an exponential development of refractive state and the effect of lenses. Near work is myopizing, as it is equivalent to wearing a negative lens.

Using a digital computer, first-order equations have been solved previously to describe and predict myopia progression [1,3]. An analogue circuit can simulate myopia progression vs. time $R(t)$ because the response of the feedback system is the same as the capacitor voltage in a R-C (Resistor-Capacitor) circuit, as shown in Figure 1. When near work is involved a negative square-wave represents the daily accommodative demand as represented in the inset in Figure 1[3]. The R-C circuit solves the problem without any computations.

The system exhibits an exponential progression of myopia [1,3].

$$R(t) = -5.00 -3 \left[ 1 - \exp\left(-\frac{t}{\tau}\right) \right]$$

where $t$ is time, $\tau$ is the time constant and $R$ is either refraction or voltage. This equation applies initially when the square wave is at -3, and then exponentials alternating with the square wave apply as described in [3].

This electrical circuit simulates myopia progression vs. time as the voltage at the capacitor, where Volts (V) represent Diopters (D), when we initialize the subject's myopia to -5 D and a negative square-wave voltage at the capacitor, where Volts (V) represent Diopters (D), when

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References