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Mini Review

Epilepsy Circle Map and Drug Resistance

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Abstract

Simple mathematical models' models for epileptic circle map and drug resistance are given.

Introduction

Epilepsy is a chronic disorder of the brain that affects people of all ages. Approximately 50 million people worldwide have epilepsy, making it one of the most common neurological diseases globally.

A modified circle map has been proposed to describe epilepsy [1]

$$X(t+1) = X(t) + c - r[\sin(\sqrt{x(t)})]^\wedge 2, \qquad (2)$$

where r,c are positive constants. The equilibrium solution is

$$\sin^2(\sqrt{x}) = \frac{c}{r} \qquad (3)$$

It is stable if

$$2 > [c(c-r)/X]^\wedge(.5) > 0 \qquad (4)$$

Contrary to the familiar circle map the MCME is Not periodic.

For the case of x(t) small such that sin(x)~x it reduces to

$$X(t+1) \sim (1-r)X(t) + c \qquad (5)$$

Its winding number is $\sim c - r\sum_1^n x(j)/n$,

Hence Arnold tongue exist so long as the winding number is rational. Here the following proposition is used:

Proposition: If f(x) is continuous and monotonic then the winding number of the system $X(t+1) = f(X(t))$ exists and is independent of the initial point.

Lyapunov exponent of (5) is ln(1-r) i.e. the equilibrium solution of (5) is locally asymptotically stable.

A relation between epilepsy and telegraph equation has been derived in [2].

In epilepsy there is a competition between drug susceptible and drug resistant species [3]:

Recently [4], it has been pointed out that competition between different species is an important factor in drug resistance. Here we give a simple model for competition between susceptible and resistant species. We denote susceptible ones by S and resistant ones by R hence we have the model:

$$ds/dt = aS(1-S) - SR, dR/dt = bSR - dR \qquad (1)$$

Where a,b and d are positive constants. It is direct to see that the coexistence solution

$$s = d/b, R = a(1-S), d/b < 1$$

is locally asymptotically stable. This agrees with observations [5].

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