Stochastic Model of Interaction of Electromagnetic Signal with Oscillator Neural Network

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Abstract

The model is suggested, which describe transfer of signals in three dimensional oscillator neural network with stochastic connections. Every oscillator has possibility connection with all another oscillators. The process of interaction of signals with oscillators, disposed in spherical region, is investigated. The results of modeling show that decreasing of width of frequency spectrums of signal and oscillators vibrations and its synchronization take place.

1. INTRODACTION

Function of oscillator neural network in the different conditions has been considered in the works [1-8]. The problem of realization of regime synchronization in the oscillator neural networks is presented large interest [3-8]. The purpose of this work is development of a numerical model of calculation interaction of electromagnetic signal with oscillator neural network. For solving the task is applied the method of interaction of electromagnetic signal with random active media [9-13].

2. THE MODEL

The model is suggested, which describe transfer of signals in three dimensional oscillator neural network with stochastic connections. Every oscillator has possibility connection with all another oscillators. It agrees with Brindly's and Marr's idea about chance disposition inter - neural networks [2]. The number of connections in a neural network approximately is equal to 1000N, where N is the quantity of neurals in a brain [1-3].The process of interaction of signals with point oscillators, disposed in spherical region is investigated. The signal is propagated from the centre of sphere, where disposed the central oscillator.

The signal propagating in the random active media is modeled by beams, which are orientated along direction of signal propagation. The direction propagation of beam is determined by stochastic manner in according to indicatrix of over-radiation of oscillator [9]. The beam is propagated on the distance [11]

$$D = -L \ln x, \tag{1}$$

where L is the middle distance between oscillators, x is a random number, in uniform distributed in the interval from 0 up to 1. Every act interaction of signal with oscillator is accompanied by displacement the frequency of signal and oscillators vibrations [9-17]. After interaction the frequency of signal and oscillator is equal to its middle frequency before interaction [4,17]. At an exit of the beam for the limits of the sphere the value of frequency of signal is saved in the computer remember. After multiple recurrence of process of tracking for beams and normalize of results we receive the spectral characteristics of the signal and oscillators.

3. RESULTS

In Figures 1-6 are presented the transformation of frequency spectrums of system oscillators (continuous curves) under influence of electromagnetic signal (shaped curves). The isotropic indicatrix of over-radiation of oscillators is considered. The sizes of frequency and power are presented in the relative units. The magnitude of power is normalized on the maximum power in the frequency spectrum. The calculation was spent for different values of radius of sphere R, which was measured in the middle length of free propagation of signal. The relative error in the calculations consist is 0.05.

Figure 1 shows the interaction of harmonic signal with system of oscillators, having normal distribution of frequency spectrums. In the result of interaction the monochromatization of frequency spectrum of oscillators vibrations and its synchronization with signal takes place. In Figure 2 is presented interaction of signal and system oscillators, having continuous frequencies spectrums. In this case takes place decreasing of frequencies spectrums of signal and system of oscillators, its normalization and synchronization. Figure 3 shows the interaction of signal with bimodal form of frequency spectrum and system of oscillators, having normal distribution of frequency spectrum. In the result of interaction the monochromatization of frequency spectrum of oscillators vibrations and its synchronization

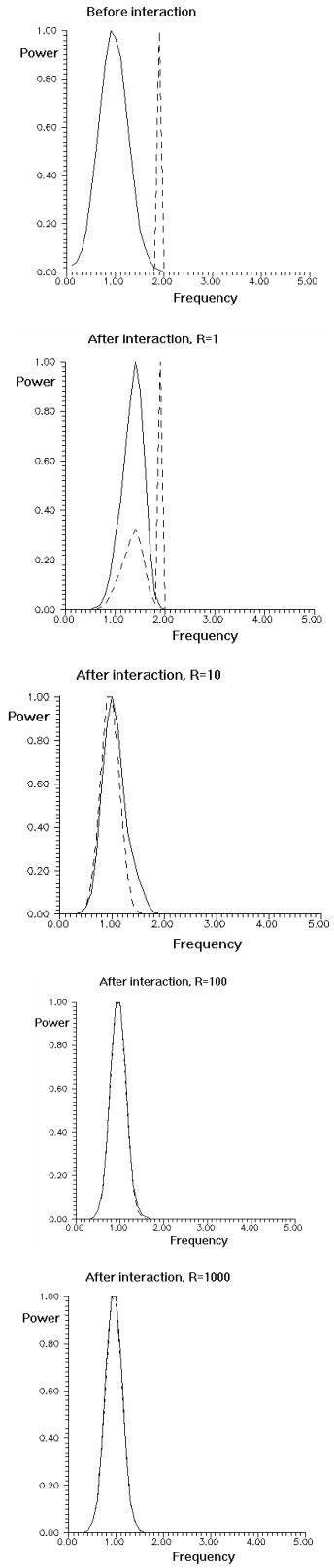


Figure 1: Transformation of discrete spectrum of signal and normal spectrum of oscillators with signal takes place.

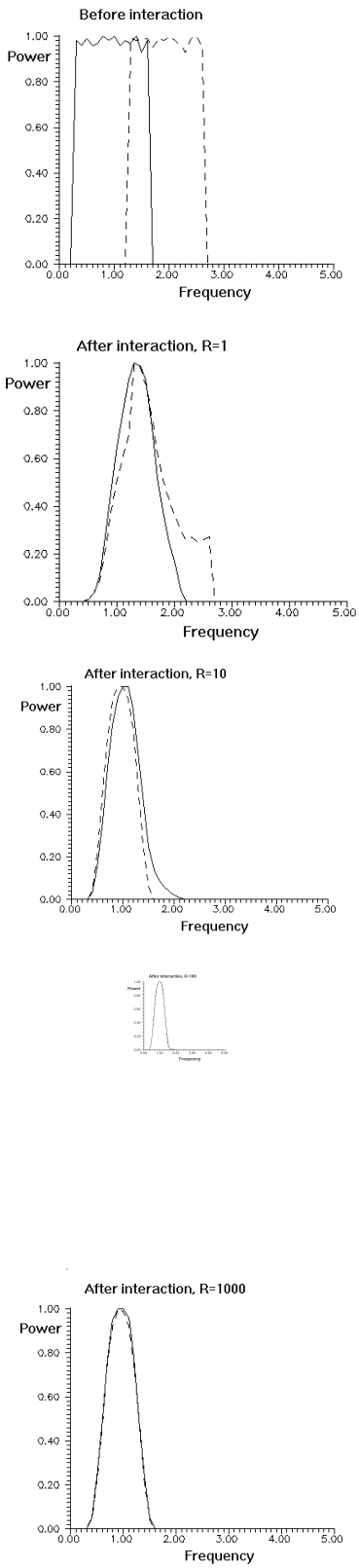
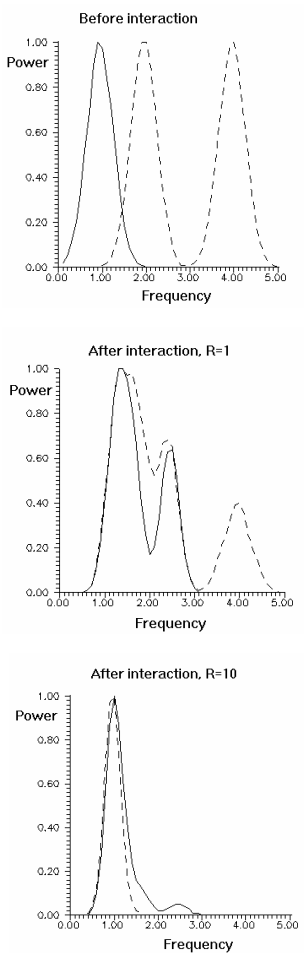
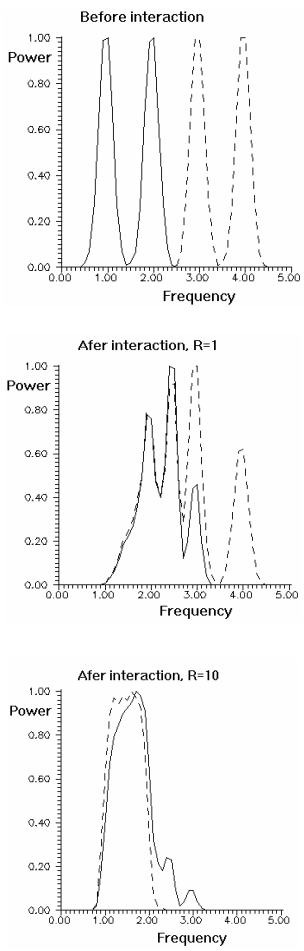


Figure 2: Transformation of continuous spectrums of signal and oscillators

In Figure 4 is presented the interaction of signal and system of oscillators, having bimodal forms of frequencies spectrums. In this case take place decreasing of frequencies spectrums of signal and system of oscillators and its synchronization. Figure 5 shows the interaction of signal, having normal spectrum and system of oscillators with discrete spectrum of vibrations. In the result of interaction the transformation of discrete spectrums of oscillators in continuous spectrum and its synchronization with signal are taken place. In Figure 6 is presented the interaction of signal and system of oscillators, having discrete forms of frequencies spectrums. In this case take place the transformation discrete spectrums of signal and oscillators in a continuous spectrums and its synchronization.

The analysis of results (Figure 1-6) shows, that the form of spectrums after interaction for R=1000 depends in more degree from the form of spectrum of oscillators vibrations before interaction.





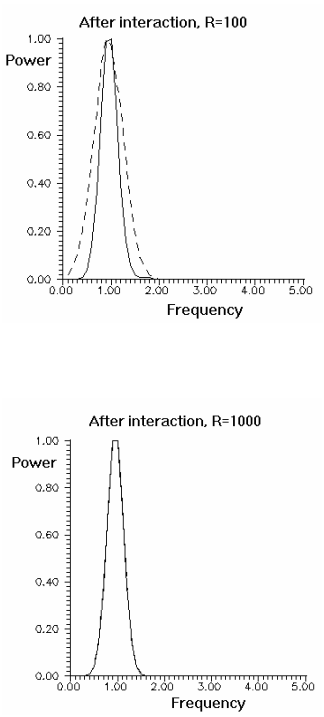


Figure 3: Transformation of bimodal spectrum of signal and normal spectrum of oscillators

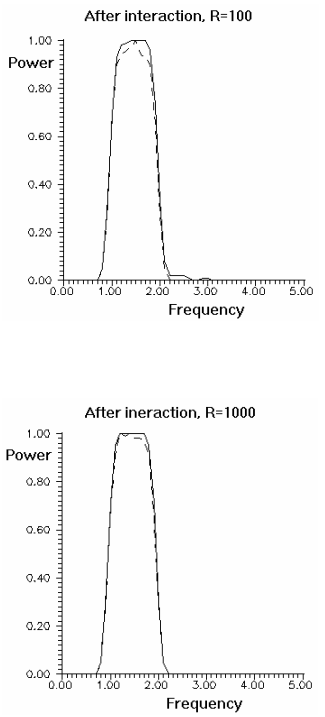
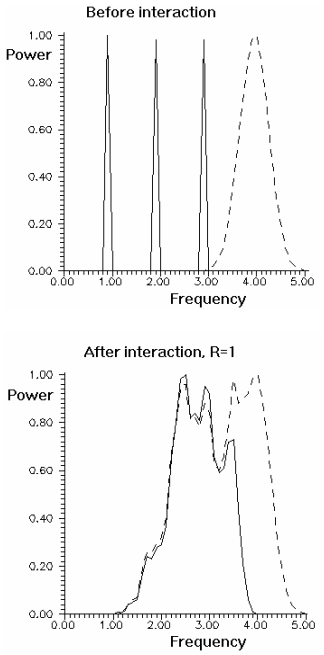
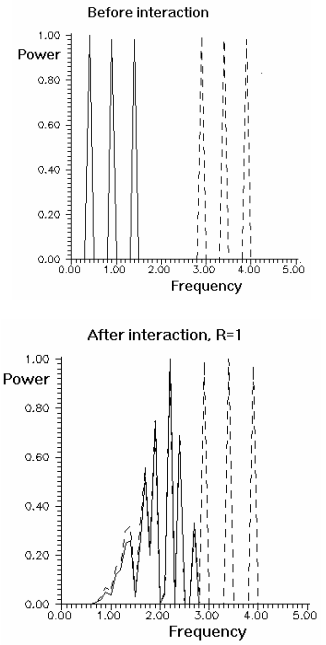


Figure 4: Transformation of bimodal spectrums of signal and oscillators





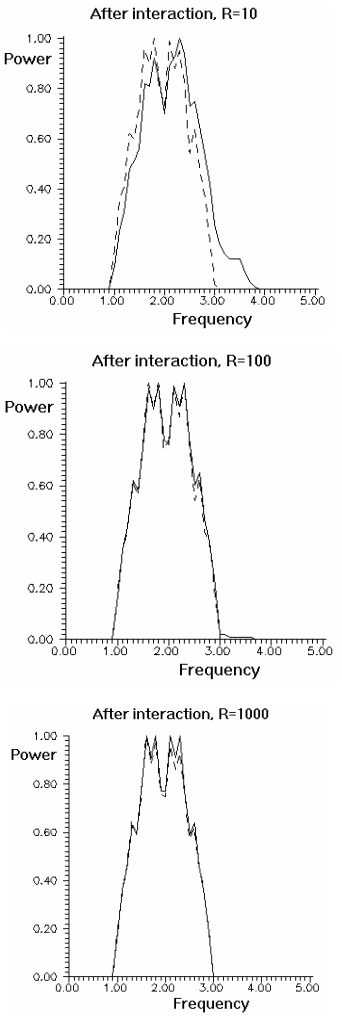


Figure 5: Transformation of normal spectrum of signal and discrete spectrum of oscillators

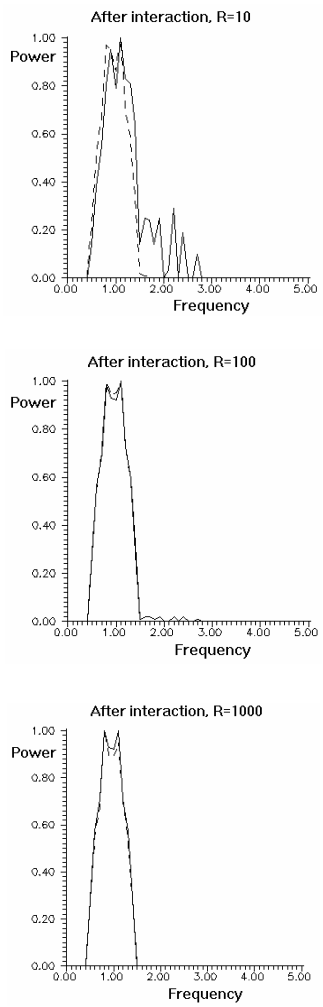


Figure 6: Transformation of discrete spectrums of signal and oscillators

4.CONCLUSION

In this work a model of interaction of electromagnetic signals with oscillator neural network has been considered. The results of modeling influence of electromagnetic signal on the oscillator neural network show decreasing of width of frequency spectrums of signal and oscillators vibrations. In the result of interaction of signal, having normal and bimodal spectrums, with system of oscillators, having normal spectrum (Figure 1,3), the monochromatization its form of spectrums takes place. In all cases (Figure 1-6) we may do the conclusion about then that in the process of multiple interaction of electromagnetic signal with oscillators its synchronization takes place.

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