Original Research Article

FM Modulated Smart Drug Algorithm for the treatment of Cancer Cells

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Abstract

This research work presents an alternative treatment method of cancer cells analogous to the earlier work entitled "Modeling and Simulation of Smart-Drug Algorithms Through Frequency Modulation for the Treatment of Covid-19 and Similar Viruses" [1]. In another words, it includes a further and extended phase of the previous research and it covers an application of the medical treatment of cancer cell viruses. Based on the analogy to be elaborated here, it is predicted that cancer cells may behave similarly to the structured RNA viruses such as Covid-19 and other coronaviruses. Therefore, it explains modeling and simulation of a smart-drug algorithm, controlled by a bio-robotic system, through Frequency Modulation (FM) for the medical treatment of cancer cells. The method discussed here is based on the assumption that the frequency variations for both the RNA configuration of the cancer cell and the drug algorithm are in sinusoidal waveform. Accordingly, when the FM range of the drug algorithm created by the bio-robotic system coincides with the range of the frequency variation of the structured RNA configuration of the cancer cell, cancer activation is terminated in a similar manner to the energy distribution produced by two mutually canceling sinusoidal wave forms. This thermodynamic interaction between the cancer cell and the drug over the boundaries of the existing open cell system will lead to the disruption of the working mechanism of the cancer cell's RNA structure. As a result, the negative effects of the cancer cell can be counteracted by slowing it down and the immune system can regain control of the body, and finally the patient's treatment will progress for the better. It is a fact that under the condition of the successful implementation of the medical treatment method described here, promising progress will be made in the treatment of cancer disease.

Keywords: Cancer treatment, covid 19, structured RNA, smart drug algorithm, bio-robotic resonance, self-vibrating frequency, bio-process, thermodynamic interaction.

1.INTRODUCTION

It is a fact that Covid-19 and other coronaviruses, as structured RNA viruses, are constantly changing their RNA configuration. Based on the earlier analogy, it is assumed that the cancer cells may behave similar to the structured RNA viruses, e.g. Covid-19 and other coronaviruses. Therefore, the medical treatment method explained by the article entitled "Modeling and Simulation of Smart-Drug Algorithms Through Frequency Modulation for the Treatment of Covid-19 and Similar Viruses" can be used for the treatment of cancer cells scientifically [1].

Because of this endless structured dynamics nature of RNAs, the drug shall not be expected to inactivate the cancer cell. It would be a correct approach to explain the interaction of the cancer cell and the drug with an analogy that treats it as a radio transmitting station that constantly changes its broadcasting frequency. Only in such a case will it be possible for the signal receiver to respond to certain changes in the broadcasting frequency and to catch the necessary frequency for listening to the broadcast. However, the fact that the radio transmitter changes the broadcasting frequency too often

requires taking into account the possibility that the rate of change in the radio transmitter frequency is greater than the capturing ability of the receiving system to detect the frequency modulation, which would ultimately not make it possible to listen to the radio broadcast. As such, it would hardly be misleading to regard the cancer cell behavior as acting like a radio transmitting station that is constantly changing its RNA configuration. By the similar logic, it would be another acceptable assumption to imagine that the drugs used to inactivate cancer cells also act as the radio-receiving systems. Therefore, it will be possible to establish a mutual analogy between the systems consisting of "cancer cell - drug" and "radio transmitter - receiver" pairs. In this work, it is aimed to develop such a methodology to eliminate the pathogenic effects of cancer cells and to treat and rehabilitate the patients suffering from the cancer disease. This methodology will be briefly referred to as "A Medical Treatment Method with Bio-robotic Resonance and Thermodynamic Interaction."

This article is briefly organized as follows: introduction of the research field and the problem description is given in the first section. Modeling and numerical simulations are given in detail in the second section. Finally, there is a conclusion section in which the work is summarized.

2. Modeling and Numerical Simulations

It is assumed that both the cancer cell RNA configuration and the smart drug algorithm have a frequency curve in the sinusoidal waveform. If the frequency modulation range created by a bio-robotic control system coincides with the frequency range of the cancer cell structured RNA configuration, cancer cell activation can be annihilated in a manner similar to the energy dissipation produced by two sinusoidal waves that cancel each other out. Drugs used for deactivating the cancer cells are assumed to behave as if they are radio receiver systems. This phenomenon is completely similar to a healthy radio broadcast, in which the frequency modulated radio wave on the transmit side is realized by modeling and simulation in which the frequency demodulation occurs on the receiving side [2].

This event, modeled as FM receiver and transmitter, was simulated in the Matlab environment [3]. The simulations were performed on an Intel Satellite labtop at 2.4 GHz with an Intel Core i7 processor running a 64-bit Operating System with 8 GB RAM and 1 Terabyte SSD hard drive as its hardware.

In the simulations, x represents the original signal, that is, the cancer cell signal with RNA configuration, and y represents the modulated signal of the drug algorithm created by the bio-robotic system. On the other hand, the demodulated signal z represents the signal that overlaps with the original signal with cancer cell. Broadly speaking, demodulation represents the one-to-one analogy of the thermodynamic interaction between the cancer cell and the smart drug algorithm. That is, the smart drug externally-controlled by a bio-robotic system shall provide a thermodynamic interaction when it encounters the cancer cell within a body cell. In other words, we are talking about a process (a.k.a. a bio-process) in which an energy transfer and mass interchange occur, providing a counterbalance between the cancer cell RNA varying frequency and the drug modulation frequency. Below we give the content of the Matlab script file in which the simulation is carried out:

% Set the sampling frequency to 1kHz and carrier frequency to 200 Hz. Generate a time vector having a duration of 0.2 s.

```
fs = 1000;
fc = 200;
t = (0:1/fs:0.2)';
```

% Create a sinusoidal signal with frequency 100 Hz. The self-vibration mutation %frequency rate for cancer cell is assumed as the same with the frequency rate of coronavirus which is 100 Hz [4].
```
x = sin(2*pi*100*t);
```

%Set the frequency deviation to 50 Hz.
```
fDev = 50;
```

%Frequency modulate x.
```
% y = fmmod(x,Fc,Fs,freqdev) returns a frequency modulated (FM) signal y,
% given the input message signal x, where the carrier signal has frequency Fc
% and sampling rate Fs.
% freqdev is the frequency deviation of the modulated signal.
y = fmmod(x,fc,fs,fDev);
```

%Plot the original and modulated signals.

```
plot(t,x,'m',t,y,'b--')
xlabel('Time (s)')
```

```
ylabel('Amplitude')
legend('Original Signal','Modulated Signal')

pause

%z = fmdemod(y,Fc,Fs,freqdev) returns a demodulated signal z, given the input %frequency modulated (FM) signal y, where the carrier signal has frequency Fc and %sampling rate Fs. freqdev is the frequency deviation of the modulated signal.
z = fmdemod(y,fc,fs,fDev);

%Plot the original and demodulated signals.
plot(t,x,'m',t,z,'b--');
xlabel('Time (s)')
ylabel('Amplitude')
legend('Original Signal','Demodulated Signal')
```
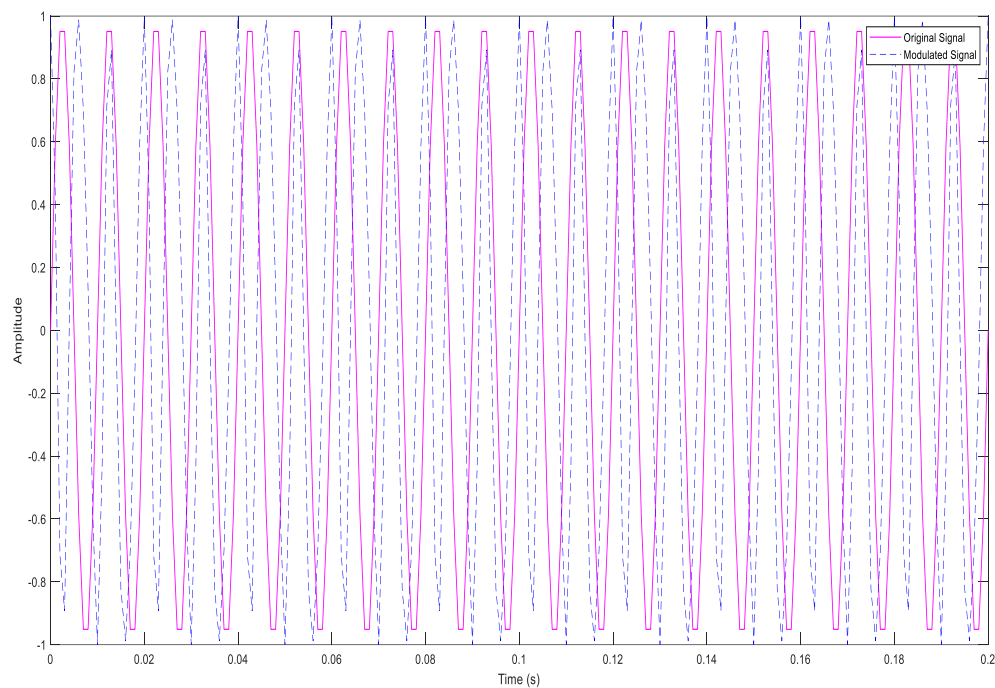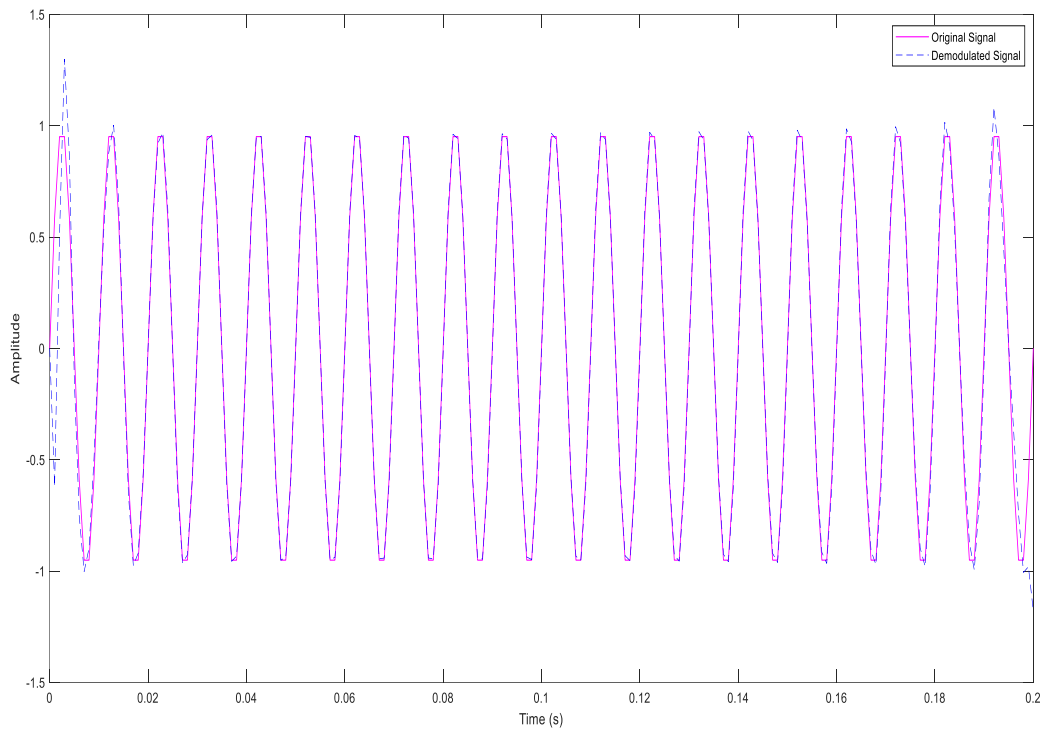
As the output of the simulation, the original signal and the modulated signals together are shown in Figure 1 and the original signal and the demodulated signal are shown in Figure 2, respectively.

Figure 1. Original signal and the modulated signal y are shown together.

Figure 2. Original signal and the demodulated signal *z* are shown together.

At this point, it would be appropriate to explain the demodulation process as follows: If the frequency variation of the structured RNA configuration can be captured, the frequency of drug algorithm may be overlapped and therefore superposed with the frequency of cancer cell RNA structure. Thus, a state of *Resonance* has been created.

As is known, we have made an assumption that speaks of the existence of a *self-vibrating frequency* due to the specific nature of the cancer cell RNA configuration. As a result of the thermodynamic balancing interaction between the two systems, frequency modulation ability of a smart drug sent into the cell externally shall capture the self-vibration frequency rate of the structured RNA configuration, and therefore the drug frequency modulation created externally shall overlap (and superpose) with the self-vibration frequency rate of the cancer cell, thus the two sinusoidal frequency waves will have absorbed each other.

Out of the analogy made above, if the rate of the variation for the radio transmitter frequency (i.e., cancer cell, coronavirus or structured RNA viruses are changing RNA configuration and permutation continuously), this is also similar to the radio transmitter (station) which varies its broadcasting frequency) is greater than the capturing ability of the frequency modulation of the receiver system, then the control algorithm has to take an effect. In this case, it can be said that the smart drug has an algorithm that works properly around an operating point and is controlled externally by a bio-robotic system [5][6].

Furthermore, the fact that the smart drug controlled by the bio-robotic system will provide a thermodynamic interaction when it encounters the cancer cell in a body cell and that energy transfer and mass exchange will take place between the drug and the cancer cell constitutes the second dimension of the event. The body cell can be considered as an open thermodynamic system that allows the energy transfer and mass interchange across the boundaries of the body cell. The above-mentioned energy transfer and mass interchange will act as a bioprocess that provides a balance between the frequency of change in the RNA configuration of the cancer cell and the modulation frequency of the drug algorithm, as if a thermodynamic process equilibrium is maintained between the two systems. Such kind of interaction may be examined within the subject of medical and structural cell thermodynamics. Assuming that a rate of self vibration frequency exists due to the specific structure of cancer cell RNA configuration, the frequency modulation ability of the smart drug externally sent into the cell to provide a treatment shall capture the self-vibration frequency. This bioprocess of energy transfer and mass exchange takes place in accordance with the theory detailed in reference [7]. This theory is based on the fact that energy and matter can have "neutral" or "negative" states, as well as "positive" aspects. The "neutral" states can also be regarded as "zero" or "stable." In each case, energy and matter have a latent potential or capacity in terms of "heat" or "work." This evaluation may indicate that both energy and matter can be considered as "vector quantitative parameters" such as "force", "velocity" and "acceleration." Therefore, the "Total Energy" can be

described as a resultant amount of positive, negative and neutral energies. Similarly, it is possible to express that the "Total Mass" can also be described as a resultant of positive, negative and neutral amounts of matter. Energy and matter have a latent potential or capacity in terms of "heat" or "work", thus these features supplement the treatment and recovery process by doing a more effective thermodynamical interaction. This also means that a medical thermodynamic interaction between drugs and body cells is necessary to achieve effective medical treatment and recovery. The entire medical treatment methodology along with the medical recovery based on the bio-process is shown in Figure 3. The bio-process mentioned here occurs with the energy transfer and the mass interchange to provide a counterbalance between the rates of the cancer cell RNA varying self-vibration frequency and the drug modulation frequency. Bio-robotic resonance is achieved by a superposition principle of the frequency waves of Radio Receiving System (RRS) and Radio Transmitting System (RTS), and hence the resonance state together with the thermodynamical interaction leads to the cancer cell destruction.
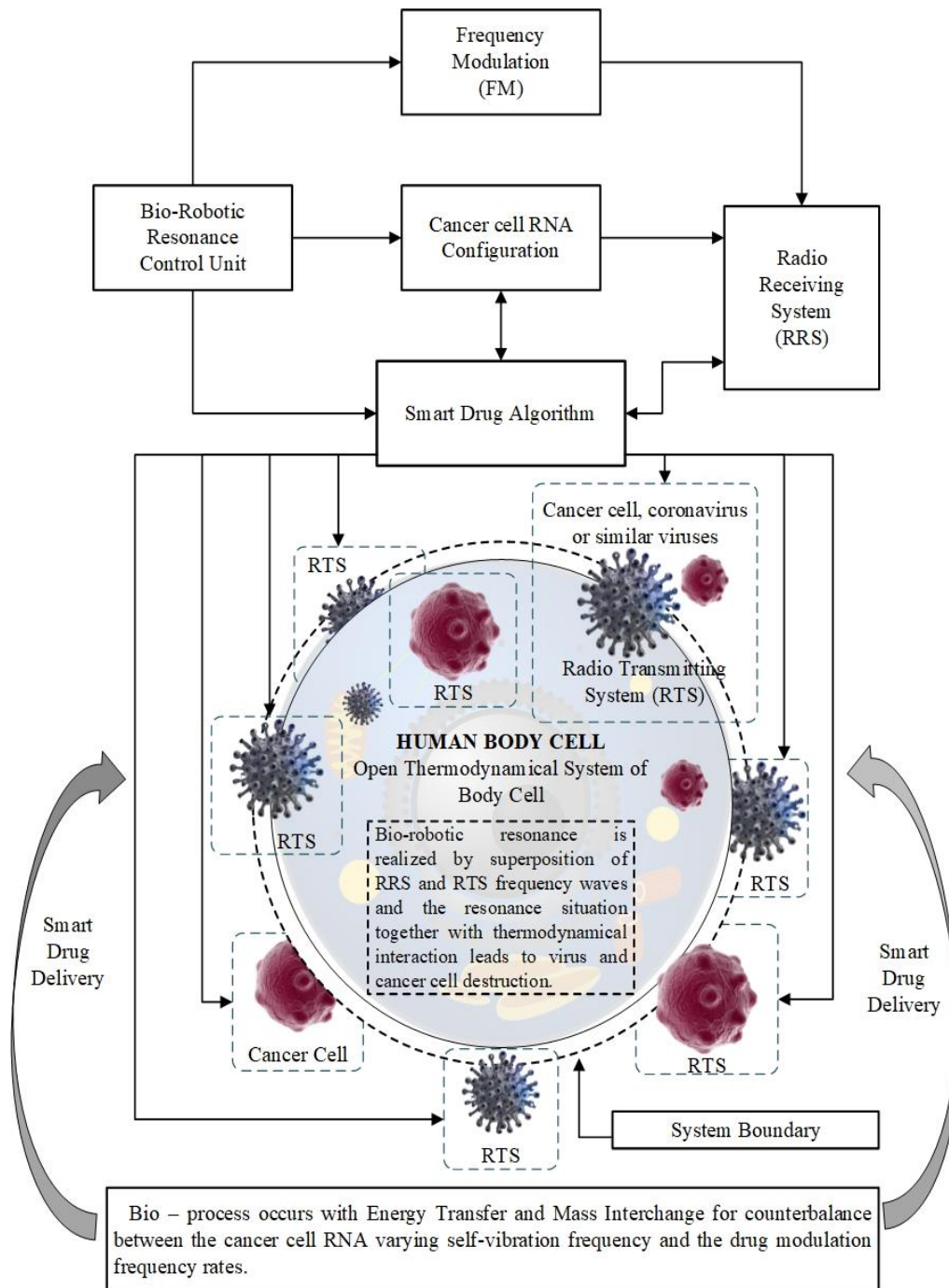
Figure 3. Schematic Block Diagram for Smart Drug Delivery by Bio-Robotic Resonance via Frequency Resonance Setting Formation.

3. CONCLUSION

Frequency rate of structured RNA configuration, and hence the drug frequency modulation created externally shall overlap and superpose with the cancer cell self-vibration frequency rate and two sinusoidal frequency wave curves shall absorb each other. Thanks to this interaction, the pathogenic effect of the cancer cell shall be eliminated and the patient would be treated. In fact, thanks to the thermodynamic interaction between the cancer cell and the drug over the boundaries of the open cell system, the working mechanism of the RNA structure of the cancer cell shall be broken. Therefore, at least the negative effects of the cancer cells can be slow down and the immune system can take the body control again. Thus, the patient's treatment progresses to the better.

The method introduced here can be called Medical Treatment Method of "Bio-robotic Resonance and Thermo dynamical Interaction" with the analogy of "Frequency – Resonance Setting Formation" on the application of "Algorithm for Smart Drugs Controlled by a Bio-robotic System" developed for the "Treatment of Cancer Cells" since the methodology treats the cancer disease by providing mainly a frequency resonance, thermo dynamical interaction, energy and mass transfer bioprocesses, respectively. It is possible to state that this treatment methodology can be developed as a unique medical technique and can also be considered as bioengineering within the applications of medical engineering. The same methodology that will be applied for the medical tteatment of cancer cells can also be used as a medical treatment method for Covid-19, coronaviruses and also of other virus types. Based on the fact that the Medical Treatment Method entitled "Bio-robotic Resonance and Thermodynamic Interaction" can be used in the treatment of cancer cells and also all kinds of viruses, it is possible to state that it can have an extremely wide range of medical applications for the benefit of humanity. [8],[9],[10],[11],[12]

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