Mathematical Model of Heart Rate

1. The objective of the research is proposed a better model for heart rate during treadmill exercise sessions.
2. For that author has proposed a model in eq 1 and describe its components as follows.
   1. X1 in the equation is change in heart rate in beats per minute (bpm) resulted from treadmill exercise.
   2. X2 is the factor added in heart rate equation to include part of other complex slow acting effects of
      1. Hormonal systems.
      2. Peripherals (legs or hands) local metabolism.
      3. Body temperature.
      4. Sweating and hyperventilation.
      5. (X2(t) –tanh(x2(t))) term is added in x2 to represent non- linearity in recovery of heart rate after exercise as heart rate will not normalize immediately after exercise.
      6. Also a factor of change in heart rate ( i.e. a5\*X1(t) ) is added in X2 to represent model as feedback system of heart rate.
   3. G(u) is the non-linear increase of heart rate in response of varying walking speed of treadmill. G(u) is selected such that it produce g=0 at 0km/hr and increase exponentially for increasing speed.
   4. Input u(t) is kept constant at v.
3. Then he measures heart rate of different subject during treadmill exercise sessions for 7, 6 and 5 km/hr speed for 15min and he measured heart rate after exercise for 20min.
4. And used parameter estimation techniques to find unknowns parameters a1, a2, a3, a4, and a5 for subject.
5. I have modeled the proposed model in matlab/simulink using estimated parameters of two subjects 1 and 2 given in the paper.
6. Then I have plotted results for heart rate for different treadmill session with different speed of 7, 6, and 5 km/hr to verify that proposed model reflect dynamics of heart rate during treadmill sessions