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On the discrete-time two coupled harmonics oscillators

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We take an assumption about the time variable in physics that actually the continuous time flow constitutes from in finite tiny discrete time steps resulting in different behavior of the system between these two time scales. To proof the assumption, the two coupled harmonic oscillators is studied as a toy model both in classical and quantum realms. In classical level, the discrete equation of motion is obtained as a discrete mapping. Under the continuum limit, a standard equation of motion is retrieved. In quantum level, the discrete wave function is obtained and interestingly the probability distribution is a bit broader than the usual one. Furthermore, the uncertainty principle in discrete-time case is modified by an extra-term containing a discrete-time parameter. Entanglement of the system is also studied by using the linear entropy in this discrete-time scale. The result shows that entanglement between two particles depends on the size of the discrete-time step and the coupling constant. As expected, the standard entanglement behavior is recovered under the continuum limit. We find that the system evolves differently in discrete-time scale comparing to the continuous-time scale.

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