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Fixed Point Iteration of a Damped and Unforced Duffing's Equation

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Abstract : The Duffing's Equation is a second order system that is very important because they are fundamental to the behaviour of higher order systems and they have applications in almost all fields of science and engineering. In the biological area, it is useful in plant stem dependence and natural frequency and model of the Brain Crash Analysis (BCA). In Engineering, it is useful in the study of Damping indoor construction and Traffic lights and to the meteorologist it is used in the prediction of weather conditions. However, most Problems in real life that occur are non-linear in nature and may not have analytical solutions except approximations or simulations, so trying to find an exact explicit solution may in general be complicated and sometimes impossible. Therefore we aim to find out if it is possible to obtain one analytical fixed point to the non-linear ordinary equation using fixed point analytical method. We started by exposing the scope of the Duffing's equation and other related works on it. With a major focus on the fixed point and fixed point iterative scheme, we tried different iterative schemes on the Duffing's Equation. We were able to identify that one can only see the fixed points to a Damped Duffing's Equation and not to the Undamped Duffing's Equation. This is because the cubic nonlinearity term is the determining factor to the Duffing's Equation. We finally came to the results where we identified the stability of an equation that is damped, forced and second order in nature. Generally, in this research, we approximate the solution of Duffing's Equation by converting it to a system of First and Second Order Ordinary Differential Equation and using Fixed Point Iterative approach. This approach shows that for different versions of Duffing's Equations (damped), we find fixed points, therefore the order of computations and running time of applied software in all fields using the Duffing's equation will be reduced.

Keywords : damping, Duffing's equation, fixed point analysis, second order differential, stability analysis
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