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CAN DYNAMICAL MODELS IN BIOLOGY AND NATURAL SCIENCES GO BEYOND INFINITY?

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Many mathematical models in the form of Ordinary (ODEs) and/or Partial Differential Equations (PDEs) trying to approximate the dynamics of biological and natural systems may in certain regimes reach infinity, i.e. blow up in finite time. Take for example the celebrated integrate-and-fire (IF) model that constitutes the backbone of many models in computational neuroscience or many population dynamics models. This "peculiar" behaviour for a physical/biological/natural sytem rises various fundamental questions: are these equations well-defined? are the selected variables the appropriate for the modelling of the systems dynamics? are there solutions beyond inifnity? To answer these questions we have addressed a numerical framework that can be applied both to ODEs and PDEs [1] that, upon suitable singular transformations allows the system to "go beyond infinity", with the solution becoming again not-singular. Thus we can study the dynamics "around infinity", bypasssing the numerical problems that are asociated with the singularity at infinity. The proposed approach sets the stage for the systematic analysis of both the numerics and the physics of dynamics that go to infinity in finite time for a broader set of such problems.

References

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