Numerical approximation of singular Forward-Backward SDEs

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Résumé

In this work, we study the numerical approximation of a class of singular fully coupled forward backward stochastic differential equations. These equations have a degenerate forward component and non-smooth terminal condition. They are used, for example, in the modeling of carbon market[9] and are linked to scalar conservation law perturbed by a diffusion. Classical FBSDEs methods fail to capture the correct entropy solution to the associated quasi-linear PDE. We introduce a splitting approach that circumvent this difficulty by treating differently the numerical approximation of the diffusion part and the non-linear transport part. Under the structural condition guaranteeing the well-posedness of the singular FBSDEs [8], we show that the splitting method is convergent with a rate 1/2. We implement the splitting scheme combining non-linear regression based on deep neural networks and conservative finite difference schemes. The numerical tests show very good results in possibly high dimensional framework.

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