SECOND ORDER BACKWARD SDES, FULLY NONLINEAR PDES AND APPLICATION TO LIQUIDITY COST

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The Feyman-Kac representation formula provides a stochastic representation for the solution of a second order linear parabolic PDE. An extension of this representation to semilinear and quasi-linear PDEs has been achieved by Pardoux and Peng by means of forward-backward SDE's. In particular, the representation in terms of the solution of a backward SDE has important implications in terms of numerical approximation by probabilistic methods. We provide an extension of the Feynman Kac representation formula to the context of fully nonlinear parabolic PDEs by introducing the class of second order backward SDEs, and we show that this extension offers similar numerical implications than the semi-linear case. As an application, we consider the problem of super-hedging under liquidity constraint, as formulated by Cetin, Jarrow and Protter. We characterize the value function of the problem as the unique solution of a fully non-linear PDE, and we provide a description of the optimal hedging strategy as a succession of Buy-and-hold and Black-Scholes type hedge.