Multidimensional stochastic Burgers equation: existence and smoothness

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We prove the existence and uniqueness of a global strong adapted solution to the multidimensional stochastic Burgers equation

$$y(t,x) = h(x) + \int_0^t [\nu \Delta y(s,x) - (y,\nabla) y(s,x) + f(s,x,y)]\,ds + \int_0^t g(s,x)\,dB_s$$

regarding the above equation as $\mathrm{C}(\mathbf{R}^n)$-valued. Our proof holds without any gradient-type assumptions on the force or the initial condition. The solution is C^2 in $x \in \mathbf{R}^n$ and α-Hölder continuous in $t \in [0,T]$ for some $\alpha < \frac{1}{2}$. Our approach is based on an interplay between PDEs and forward-backward SDEs. Moreover, we show that as the viscosity goes to zero, the solution of the viscous stochastic Burgers equation converges uniformly to the local strong adapted solution of the inviscid stochastic Burgers equation.