Burgers turbulence subject to a force $f(x,t) = \sum_j f_j(x)\delta(t-t_j)$, where the $t_j$ are ‘kicking times’ and the ‘impulses’ $f_j(x)$ have arbitrary space dependence, combines features of the purely decaying and the continuously forced cases. With large-scale forcing this ‘kicked’ Burgers turbulence presents many of the regimes proposed by E et al. (1997) for the case of random white-noise-in-time forcing. It is also amenable to efficient numerical simulations in the inviscid limit, using a modification of the fast Legendre transform method developed for decaying Burgers turbulence by Noullez and Vergassola (1994). For the kicked case, concepts such as ‘minimizers’ and ‘main shock’, which play crucial roles in recent developments for forced Burgers turbulence, become elementary since everything can be constructed from simple two-dimensional area-preserving Euler-Lagrange maps.

The main results are for the case of identical deterministic kicks which are periodic and analytic in space and are applied periodically in time. When the space integrals of the initial velocity and of the impulses vanish, it is proved and illustrated numerically that a space- and time-periodic solution is achieved exponentially fast. In this regime, probabilities can be defined by averaging over space and time periods. The probability densities of large negative velocity gradients and of (not-too-large) negative velocity increments follow the power law with $-7/2$ exponent proposed by E et al. (1997) in the inviscid limit, whose existence is still controversial in the case of white-in-time forcing. This power law, which is seen very clearly in the numerical simulations, is the signature of nascent shocks (preshocks) and holds only when at least one new shock is born between successive kicks.

“It is shown that the third-order structure function over a spatial separation $\Delta x$ is analytic in $\Delta x$ although the velocity field is generally only piecewise analytic (i.e. between shocks). Structure functions of order $p \neq 3$ are non-analytic at $\Delta x = 0$. For even $p$ there is a leading-order term proportional to $|\Delta x|$ and for odd $p > 3$ the leading-order term $\propto \Delta x$ has a non-analytic correction $\propto \Delta x|\Delta x|$ stemming from shock mergers.”