

Branching random motions, nonlinear hyperbolic systems and traveling waves

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It is known that under certain assumptions for nonlinearities the following coupled nonlinear hyperbolic equations

$$\begin{cases} \frac{\partial u_+}{\partial t} - c \frac{\partial u_+}{\partial x} = \mu_+(u_- - u_+) - \lambda_+ u_+ + F_+(u_+, u_-), \\ \frac{\partial u_-}{\partial t} + c \frac{\partial u_-}{\partial x} = \mu_-(u_+ - u_-) - \lambda_- u_- + \lambda_- F_-(u_+, u_-), \end{cases}$$

have traveling-wave solutions.

We realize the McKean's program [1] for the Kolmogorov-Petrovskii-Piskunov equation in this hyperbolic case.

A branching random motion on a line, with abrupt changes of direction, is studied. The branching mechanism, being independent of random motion, and intensities of reverses are defined by a particle's current direction. A solution of a certain hyperbolic system of coupled non-linear equations (Kolmogorov type backward equation) have a so-called McKean representation via such processes. Commonly this system possesses travelling-wave solutions. The convergence of solutions with Heaviside terminal data to the travelling waves is discussed.

The Feynman-Kac formula plays a key role, [2].

References

- [1] H.P. McKean, *Application of Brownian motion to the equation of Kolmogorov-Petrovskii-Piskunov*, Comm. Pure Appl. Math. XXVIII (1975), 323-331.
- [2] N. Ratanov, *Branching random motion, nonlinear hyperbolic systems and travelling waves*, ESAIM: Probability and Statistics, **10** (2006), 236-257