Abstract

The focus of this study is to use the Lie symmetry method to reduce and solve the difference equations. We first perform an invariance analysis of a class of the nonlinear time-independent Schrödinger second order difference equation where the discrete version is obtained by some discretization procedure. The invariance approach adopted is the Lie symmetry approach, and thereafter, we construct the first integrals of the discrete equation. Furthermore, we check whether there exists an 'association' between the symmetries and the first integrals. Reductions to obtain solutions are then presented.

In the next step, we perform a symmetry analysis of some nonlinear partial difference equations (P$\triangle$Es). The discrete versions of the wave, diffusion, Fisher, Huxley, Fitzhugh-Nagumo and KPP (KPP) equations are analysed. The first integral technique which Hydon introduced is used with discrete ordinary difference equations (O$\triangle$Es). We developed a similar technique for generating the first integral vectors of the nonlinear P$\triangle$Es without recourse to symmetry generators.

Finally, we perform a discrete symmetry analysis of some nonlinear partial differential equations (PDEs), such as the Vakhnenko-Parkes (VP) and Thomas equations. We introduced an algorithmic method to determine the discrete symmetries of differential equations. New invariant solutions are obtained by applying discrete symmetries to the aforementioned equations. We also discuss a graphical interpretation of the solutions obtained using Mathematica. The obtained results motivate us to continue this study in the future.