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Scaling invariant Lax pairs of nonlinear evolution equations.

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Authors' abstract: A completely integrable nonlinear partial differential equation (PDE) can be associated with a system of linear PDEs in an auxiliary function whose compatibility requires that the original PDE is satisfied. This associated system is called a Lax pair. Two equivalent representations are presented. The first uses a pair of differential operators which leads to a higher order linear system for the auxiliary function. The second uses a pair of matrices which leads to a first-order linear system. In this article, we present a method, which is easily implemented in MAPLE or MATHEMATICA, to compute an operator Lax pair for a set of PDEs. In the operator representation, the determining equations for the Lax pair split into a set of kinematic constraints which are independent of the original equation and a set of dynamical equations which depend on it. The kinematic constraints can be solved generically. We assume that the operators have a scaling symmetry. The dynamical equations are then reduced to a set of nonlinear algebraic equations. This approach is illustrated with well-known examples from soliton theory. In particular, it is applied to a three parameter class of fifth-order Korteweg-de Vries (KdV)-like evolution equations which includes the Lax fifth-order KdV, Sawada-Kotera and Kaup-Kuperschmidt equations. A second Lax pair was found for the Sawada-Kotera equation. *Dafeng Zuo (Hefei)*

Keywords: Lax pair; Lax operator; scaling symmetry; complete integrability; fifth-order KdV-type equations
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