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Some new integrable systems constructed from the bi-Hamiltonian systems with pure differential Hamiltonian operators

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When both Hamiltonian operators of a bi-Hamiltonian system are pure differential operators, we show that the generalized Kupershmidt deformation (GKD) developed from the Kupershmidt deformation in \cite{kd} offers an useful way to construct new integrable system starting from the bi-Hamiltonian system. We construct some new integrable systems by means of the generalized Kupershmidt deformation in the cases of Harry Dym hierarchy, classical Boussinesq hierarchy and coupled KdV hierarchy. We show that the GKD of Harry Dym equation, GKD of classical Boussinesq equation and GKD of coupled KdV equation are equivalent to the new integrable Rosochatius deformations of these soliton equations with self-consistent sources. We present the Lax Pair for these new systems. Therefore the generalized Kupershmidt deformation provides a new way to construct new integrable systems from bi-Hamiltonian systems and also offers a new approach to obtain the Rosochatius deformation of soliton equation with self-consistent sources.

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