Relationship Between Two Classes of Shape-Invariant Potentials

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Abstract: We show that two classes of shape-invariant potentials are interrelated to each other. For all one-dimensional shape-invariant potentials with parameters related by translation, i.e. the first class of shape-invariant potentials (SIP1), we can find their multi-parameter deformations with q acting as the deformation parameter, i.e. the second class of shape-invariant potentials (SIP2) with parameters related by scaling. In order to get closed solution of SIP2, we consider two infinitesimal intervals, one is close to q=0 another close to q=1, and show that in these intervals we can get separately two first-order approximate solutions in closed form, furthermore we prove that all SIP1 can be obtained by the limiting procedures for corresponding SIP2.

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