Self-similar renormalization for nonlinear problems

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A new method, called the method of self-similar approximants, and its recent developments are described. The method is based on the ideas of renormalization group theory and optimal control theory [1–6]. It allows for the effective extrapolation of asymptotic series in powers of small variables to the finite and even to infinite variables. The approach is proved to be regular. It is illustrated by several examples demonstrating good agreement with numerical calculations. The method is shown to provide accurate approximate solutions to complex nonlinear problems. In some cases, the method allows for the reconstruction of exact solutions on the basis of rather short perturbative series.

References

[1] V.I. Yukalov and E.P. Yukalova, Phys. Lett. A **368**, 341–347 (2007).

[2] V.I. Yukalov and S. Gluzman, Phys. Rev. D **91**, 125023 (2015).

[3] V.I. Yukalov, Phys. Part. Nucl. **50**, 141–209 (2019).

[4] V.I. Yukalov and E.P. Yukalova, Int. J. Mod. Phys. B **34** 2050208 (2020).

[5] V.I. Yukalov and E.P. Yukalova, Phys. Rev. D **103**, 076019 (2021).

[6] 6. V.I. Yukalov and E.P. Yukalova, Phys. Lett. A **425**, 127899 (2022).