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# Towards symmetric discretization schemes via weak boundary conditions

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The Szymanzik improvement program for gauge theories is most commonly implemented using forward finite difference corrections to the Wilson action. Central symmetric schemes (see e.g. [1]) naively applied, suffer from a doubling of degrees of freedom, identical to the well known fermion doubling phenomenon. And while adding a complex Wilson term remedies the problem for fermions, it does not easily transfer to real-valued gauge fields.

In this talk I report on recent progress in formulating symmetric discretization schemes for classical actions of simple one-dimensional problems [2]. They avoid doubling by exploiting the weak imposition of initial/boundary conditions. Inspired by recent work in the field of numerical analysis of partial differential equations, I construct a regularized summation-by-parts finite difference operator using affine coordinates, which is combined with Langrange multipliers to impose the boundary conditions weakly. Application to classical initial value problems with first and second order derivatives are presented.

[1] A. Rothkopf, arXiv:2102.08616
[2] A. Rothkopf, J. Nordström arXiv:2205.14028

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