

GEOMETRIC AND ASYMPTOTIC GROUP THEORY
WITH APPLICATIONS
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*On the dimension of matrix embeddings of torsion-free nilpotent
groups*

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Abstract:

In 2006, Nickel proposed an algorithm to calculate embeddings of torsion-free nilpotent groups into unitriangular integer matrices $UT_N(\mathbb{Z})$. In this work, we show that if $UT_n(\mathbb{Z})$ is embedded into $UT_N(\mathbb{Z})$ using Nickel's algorithm, then $N \geq 2^{n/2-2}$ if the standard ordering of the Mal'cev basis as in Nickel's original paper is used. In particular, we establish an exponential running time of Nickel's algorithm. On the other hand, with a different Mal'cev basis, the embedding has only quadratic size. We also prove a general exponential upper bound on the dimension of the embedding by showing that for any torsion free, finitely generated nilpotent group the matrix representation produced by Nickel's algorithm has never larger dimension than Jennings' embedding. Finally, we consider some other special cases like free nilpotent groups and Heisenberg groups.