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Approximations of groups, characterizations of sofic groups, and equations over groups.

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Abstract

We give new characterizations of sofic groups:

- A group G is sofic if and only if it is a subgroup of a quotient of a direct product of alternating or symmetric groups.
- A group G is sofic if and only if any system of equations solvable in all alternating groups is solvable over G .

The last characterization allows to express soficity of an existentially closed group by $\forall\exists$ -sentences.

Keywords: sofic groups, approximations, equations over groups.

2010 MSC: 20E26, 20E18

1. Introduction

In [1, 2], sofic groups have been defined¹ in relation with the Gottschalk surjectivity conjecture. Hyperlinear groups have been introduced in relation with Connes' embedding conjecture, [4]. It is known that sofic groups are hyperlinear, the reverse inclusion is an open question.

Some famous group theory conjectures (Kervaire-Laudenbach, Gottschalk, Connes' embedding conjectures) are established for sofic groups, see [5, 6] and the references therein. It is also known that some important classes of groups are sofic, for example, amenable, residually amenable, extensions of sofic groups by amenable groups, etc., [7, 5, 6]. An open question is whether all groups are sofic (respectively, hyperlinear).

Classically, sofic (hyperlinear) groups are defined as being metric approximable by symmetric groups (resp. finite-dimensional unitary groups), [8]. It is also possible to define metric approximations by different classes of groups, see [9] and Definition 3 of the present paper. We call them $(\mathcal{K}, \mathcal{L})$ -approximations,

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¹Definition 3.5 of [3] is the definition of sofic groups where the authors missed the separability conditions. All groups trivially satisfy this definition.

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