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Paula Escorcielo, Daniel Perrucci

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On the Davenport-Mahler bound

Paula Escorcielo* Daniel Perrucci*

Departamento de Matemática, FCEN, Universidad de Buenos Aires, Argentina
IMAS, CONICET–UBA, Argentina

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Abstract

We prove that the Davenport-Mahler bound holds for arbitrary graphs with vertices on the set of roots of a given univariate polynomial with complex coefficients.

Introduction

The Davenport-Mahler bound is a lower bound for the product of the lengths of the edges on a graph whose vertices are the complex roots of a given univariate polynomial $P \in \mathbb{C}[X]$, under certain assumptions. Its origins are the work of Mahler ([10]), where a lower bound for the minimum separation between two roots of P in terms of the discriminant of P is given, and the work of Davenport (see [2, Proposition 8]), where for the first time a lower bound for the joint product of many different distances between roots of P (which is not simply the product of a lower bound for each distance) is obtained. Roughly speaking, this bound makes evident an interaction between the involved distances, in the sense that if some of them are very small, the rest cannot be that small.

Throughout the literature, there are different versions of this bound. We include here the one from [5, Theorem 3.1] (see also [7, 12]). First, we remind the definitions of discriminant and Mahler measure (see also [1, 11]).

Definition 1 *Let* $P \in \mathbb{C}[X]$, $P(X) = a_d \prod_{i=1}^d (X - v_i)$, *the* discriminant *of* P *is*

$$\mathrm{Disc}(P) = a_d^{2d-2} \prod_{i<j} (v_i - v_j)^2.$$

Definition 2 *Let* $P \in \mathbb{C}[X]$, $P(X) = a_d \prod_{i=1}^d (X - v_i)$, *the* Mahler measure *of* P *is*

$$M(P) = |a_d| \prod_{i=1}^d \max\{1, |v_i|\}.$$

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