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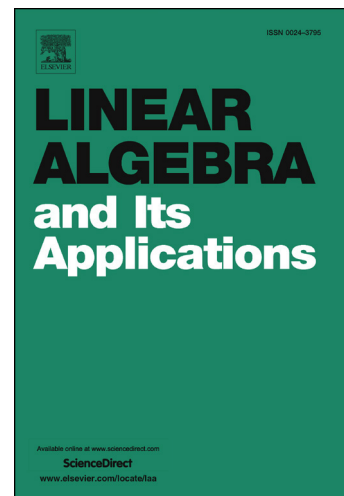
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On the bivariate permanent polynomials of graphs*

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Abstract

In 1980, Balasubramanian and Parthasarathy introduced the bivariate permanent polynomials of graphs and conjectured that this polynomial is a graph characterizing polynomial, that is, any two graphs with the same bivariate permanent polynomial are isomorphic. In this paper, we give counterexamples to this conjecture by a computer search. Furthermore, we show that several well-known families of graphs are determined by the bivariate permanent polynomial: complete graphs, complete bipartite graphs, regular complete multipartite graphs, cycles and their complements.

Keywords: Permanent; Bivariate permanent polynomial

2010 Mathematics Subject Classification: 05C31, 05C50, 15A15

1 Introduction

A graph invariant is a function f from the set of all graphs \mathcal{G} into any commutative ring R such that f takes the same value on isomorphic graphs. When R is a ring of polynomials in one or more variables, the invariant f is called an invariant polynomial for graphs (or a *graph polynomial*). As a graph invariant, f can be used to check whether two graphs are not isomorphic. If a graph polynomial f also satisfies the converse condition that $f(G) = f(H)$ implies G and H are isomorphic, then f is called a *graph characterizing polynomial*.

Many graph polynomials have been defined and extensively studied, such as the characteristic, chromatic, matching, and Tutte polynomials. Besides their intrinsic interest, they encode useful combinatorial information about the given graph. In general, graph polynomials have been developed for measuring combinatorial graph invariants and for characterizing graphs. The latter is related to the graph isomorphism problem and it is of interest to determine the ability to characterize graphs for any graph polynomial [12]. One might ask whether or not we can find a graph characterizing polynomial. To date, no useful graph characterizing polynomials have been found. Indeed, all the graph polynomials mentioned above are not graph characterizing polynomials.

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