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COMPOSITIONS OF REACTION SYSTEMS

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ABSTRACT

The *reaction systems* introduced by Ehrenfeucht and Rozenberg have turned out widely applicable in describing various biological phenomena and chemical reactions. However, the model itself constitutes an interesting framework for the study of functions over a finite set. This paper continues theoretical investigations of the minimal model of reaction systems by introducing the notion of a composition. Compositions of minimal reaction systems give rise to functions not definable by minimal reaction systems but the possibilities are still limited. In many cases the powerful composition theory of functions over a finite domain can be applied.

Keywords: reaction system, composition of functions, union-additive, reactant, inhibitor, cycle length

1. Introduction

All constructions dealing with a *reaction system*, [4], take place within a fixed finite set S, referred to as the *background set*. Thus, mathematically, we are working on functions and sequences over a finite set. We are concerned only with the *basic variant* of reaction systems in this paper. The reader may consult [1] for more complicated variants.

For the sake of completeness, we now outline the basic definitions.

Definition 1 *A* reaction *over the finite nonempty* background set S *is a triple*

$$\rho = (R, I, P),$$

where R, I *and* P *are* nonempty *subsets of* S *such that* R *and* I *do not intersect. The three sets are referred as* reactants, inhibitors *and* products, *respectively. A* reaction system $\mathcal{A}_S$ *over the background set* S *is a finite nonempty set*

$$\mathcal{A}_S = \{\rho_j | \ 1 \leq j \leq k\},$$

of reactions over S*.*

In this paper S will always denote the background set. We will in this paper omit the index S from $\mathcal{A}_S$. The *cardinality* of a finite set X is denoted by $\sharp X$. The *empty set* is denoted by $\emptyset$.