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Bibliography on Nullors and Their Applications in Circuit Analysis, Synthesis and Design

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Abstract. A bibliography on research work related to 'nullors' and their applications in circuit analysis, synthesis and design, covering the period 1961–2000, is given.

Key Words: nullors, circuit design, analog electronics, active network synthesis

1. Introduction

Ever since the introduction of 'nullator' and 'norator,' by Carlin and Youla in 1961 [1], and the *'nullor'* by Carlin in 1964 [2], (though the basic ideas lying therein were introduced by Tellegen[1] as early as 1954), these *pathological (degenerate)* elements have been quite often used in linear (and occasionally nonlinear) circuit analysis, synthesis and design. Because nullors can be used to represent a variety of different active elements such as BJT, FET, Op-amp, Current Conveyor, Voltage follower, Current follower, Operational Transconductance Amplifiers (OTA) etc., they provide a unified framework for not only analysis and design of active networks but also for interrelating the realisations using different active elements. Several ways of implementing 'four terminal floating nullors' (FTFN), using off-the-shelf IC components are known in literature for instance, see [183,199,208,231,325,351]. With the recent emergence of a number of integratable circuits of FTFNs (for instance, [113,219,226,253,348,350]), coupled with renewed interest in their direct employability as building blocks in both, voltage mode and current mode circuit design such as [199,208,231, 238,247,248,254,258,264,270,284,286,295,296,299, 301–305,308–311,315,316,318,319,324,325,328,343, 351–354], nullors are fast becoming attractive and prominent active elements for analog signal processing/generation in their own right. Because of the aforementioned reasons nullors are being regarded as 'universal active elements' [208,219,226,253,256,262, 274,293] as envisaged in early seventies.

In view of the above, therefore it appears timely to present a bibliography[2] on nullators, norators and nullors and their applications in circuit analysis, synthesis and design. As far as is known, no other bibliographic compilation has so far been published in the open literature on this topic yet.

The present compilation, thus, attempts to fill this void and has included papers whose texts and/or abstracts were available in English language. Furthermore, although several works on circuit realisations using CCs and other voltage mode or current mode building blocks which have appeared in the literature from time to time can, in retrospect, be now related to the concept of nullors, we have restricted ourselves to only those works where 'nullators, norators or nullors' have been mentioned or employed *explicitly*.

An attempt has also been made to classify the papers into various categories. In all, four categories have been considered and the category (categories) to which a particular paper belongs, has (have) been indicated at the end of the reference within brackets. The various categories are as follows.

(i) Analysis using nullors [A]: In this category those papers are included in which nullors have been used in the analysis or else the paper deals with the methods of analysis of circuits containing nullors.
(ii) Application of nullors in circuit synthesis and design [D]: This category includes papers in which

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nullors have been used for synthesis and design of various kinds of circuits such as design of active filters [DF], design of sinusoidal oscillators [DO], design of synthetic immittances [DI], and design of other general networks [DG].

(iii) Hardware implementation of nullors [H]: This category includes those works, which deal with the hardware implementation of the nullor itself.

(iv) Miscellaneous [M]: This category deals with those works, which do not fall into any of the above mentioned categories.

The present compilation is arranged in chronological order with papers belonging to a particular year being arranged in alphabetic order in respect of the first author.

Notes

1. B. D. H. Tellegen, "La recherche pour una série compléte d' éléments de circuit ideaux nonlinéaires." Rendiconti del Seminario matemtico e Fiscio di Milano 25, pp. 144–144, 1954.
2. We have tried to be as comprehensive as possible. But the period of coverage being almost four decades, there may have been some (un-intentional!) omissions. We would welcome if missing references (if any) may be brought to the notice of the authors.

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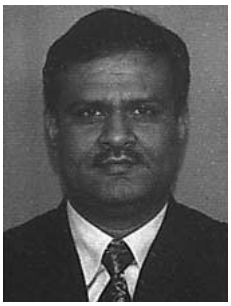

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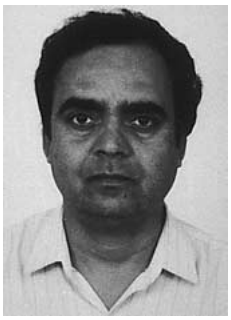

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