A Bibliometric Profile of *MATCH Communications in Mathematical and in Computer Chemistry*

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Abstract

This paper describes the bibliometric characteristics of 1,319 articles published in the journal *MATCH Communications in Mathematical and in Computer Chemistry*, in the period 1995-2014. These articles have been analysed using data from the *Web of Science Core Collection*and demonstrate the contribution of the journal not only to mathematical and computer chemistry but also to science more generally.

1 Introduction

The first edition of the journal *MATCH Communications in Mathematical and in Computer Chemistry* appeared in 1975. It was initially named *MATCH Informal Communications in Mathematical Chemistry*, changed to *MATCH Communications in Mathematical Chemistry* in 1980, and gained its current name in 1997, as described in detail by Gutman in a history of the journal that was published in 2005 [1]. Whilst the name may have changed during its forty years, the aim has remained constant in seeking to bridge the gap between mathematics and chemistry, with the journal's webpage stating that it "publishes papers of original research as well as reviews on chemically important mathematical results and non-routine applications of mathematical techniques to chemical problems. A paper acceptable for

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publication must contain non-trivial mathematics or communicate non-routine computer-based procedures AND have a clear connection to chemistry".

This brief paper seeks to provide a bibliometric profile of the journal (which will subsequently be referred to simply as *MATCH*), where bibliometrics is the name given to a body of techniques for the quantitative analysis of a set of publications that are characterised by bibliographic features such as authors, places of publication or citations. In the present context, the set of publications is the articles that have appeared in *MATCH* and that have been indexed in the Thomson-Reuters *Web of Science Core Collection* database (hereafter *WoS*). Coverage of *MATCH* in *WoS* commenced with volume 32 in 1995 and searches of the database in January 2016 showed a total of 1,373contributions to the journal up to and including volume 72 in 2014. The discussion that follows is based on the 1,319 articles, conference papers and reviews (which will jointly be referred to as articles in the following) that remained after the removal of editorial material, corrections, biographical notes *etc.*

2 Publication data

Contributions to *MATCH* have increased markedly over the 20 years considered here, as illustrated in Figure 1 and reflecting the growing interest in the subject. The substantial increase between 2000-04 and 2005-09 arises from the introduction of multi-issue volumes from volume 53 in 2005 onwards, whereas each volume had previously consisted of just a single issue.

These 1,319 articles are the work of 1,292 different authors. As would be expected, there is a highly skewed distribution with no less than 791 of the authors having contributed just once but with others making very substantial contributions to the journal. The ten most productive authors are I. Gutman (115 articles), B. Zhou (45), M. V. Diudea (44), X. L. Li (40), S. Fujita (34), A. R. Ashrafi and A. Iranmanesh (both 33), B. Liu and H. Deng (both29) and D. Vukičević (24): after taking account of joint publications, these ten authors alone have provided 29.1% of the articles, and several of them figure in a recent network analysis of scientific collaborations based on publications in *MATCH* [2].

The distribution for the 66 distinct nations of origin is comparably skewed with the People's Republic of China (PRC) contributing some 465 articles. This is then followed by Iran (145), Serbia (117), Germany (97), Slovenia (85), USA (82), Romania (64), Croatia (57), Japan (41) and Italy (32). The dominant position of the PRC is a recent one, with only 35 of

its 465 articles appearing in the first ten years (1995-2004) considered here. Its increasing prominence is reflected in five of the ten most-productive institutions coming from the PRC,
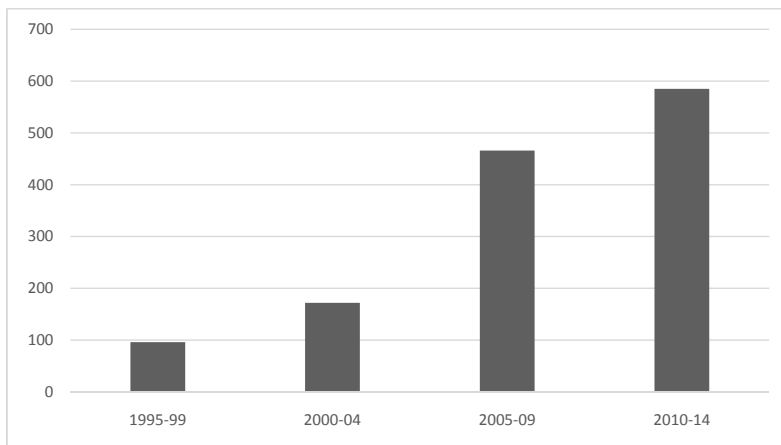
Figure 1. Numbers of articles published in *MATCH* over the period 1995-2014.

viz the universities of South China Normal, Nankai, Lanzhou, Hunan Normal and Xiamen. The other five most-productive institutions are the universities of Kragujevac (Serbia), Babes Bolyai (Romania), Kashan and Tarbiat Modares (both Iran), and Ljubljana (Slovenia).

While the increasing volume of research from the PRC has been noted in many disciplines [3, 4], the other countries that have made substantial contributions to *MATCH* are quite different from those in journals that focus on other aspects of computational chemistry. For example the most productive countries for the period 1995-2014 for the *Journal of Computational Chemistry* are USA, PRC, Germany, Spain, Japan, France, UK, Italy, Canada and Switzerland; and those for the *Journal of Chemical Information and Modeling* are USA, Germany, UK, PRC, Italy, France, Japan, Spain, India and Switzerland. The very different behaviour observed for *MATCH* appears to arise from the significant contributions to the journal that have been made by individual groups, e.g., the Serbian contribution arises from the work of Gutman at Kragujevac, and the Iranian one from the work of Iranmanesh at Tarbiat Modares and of Ashrafi at Kashan, respectively. A strong individual contribution is also evident in the 1,934 articles published in 1995-2004 in the *Journal of Mathematical Chemistry*, which is probably closest in subject focus to *MATCH*. The order here is PRC,

USA, Spain, Turkey, Canada, UK, Poland, Greece, India and Hungary, with much of the prominence of Spain arising from the work of the Girona group under Carbó-Dorca.

(a)

(b)

Figure 2. Word-clouds based on title words extracted from articles published in *MATCH* over the periods (a) 1995-2004; (b) 2005-2014.

The content of the 1,319 *MATCH* articles is summarised in the two word-clouds (produced using Wordle at http://www.wordle.net/) shown in Figure 2, where the size of each word is proportional to its frequency of occurrence within the titles (after the removal of stop-words and the conflation of obvious word variants, e.g., "bond" and "bonds", to the singular form). Figure 2(a) covers the 268 articles published in 1995-2004 and Figure 2(b) the 1051 published in 2005-2014. The prominent words here, most obviously "graph" and "index" but also words such as "polynomial", "topological" and "Wiener", are well represented for both time periods and will come as no surprise to regular readers of the journal. There are differences however; for example, the greater prominence of "benzenoid" and "enumeration" in 2(a) and the appearance of biological terms such as "DNA" and "protein" in 2(b) illustrating the growth of bioinformatics over the last decade.

3 Citation data

To date (early February 2016), the 1,319 *MATCH* articles have attracted a total of 10,779 citations, this figure including self-citations (i.e., citations by authors to their previous publications). The citations have come from 3,679 citing articles, with a mean of 8.17 citations per article and an *h*-index value of 37. The growth in citations is illustrated in Figure 3, and the ten most cited articles are listed in the Appendix, where it will be seen that they cover a wide range of topics, including nanostructures, molecular descriptors and graph theory *inter alia*. The reader should note that these citations are total counts, and there is hence an obvious bias toward the older articles, since they have had a longer period in which to accrue citations.

The most cited article in the journal is that by Li and Shi. Although not categorized as such by *WoS*, this is a review and contributions of this type are often more extensively cited than individual research articles. Not only has this contribution been widely cited but it has attracted these citations from a range of different sources. Of these, 25 are journal self-citations, i.e., citations from articles that have appeared in *MATCH* itself, but there are also 24 from *Applied Mathematics and Computation*, 7 from *Ars Combinatoria*, 5 from *PLoS ONE* and the remainder from ten other, mainly mathematical journals. An analogous picture arises if one considers the entire set of citations to *MATCH* articles. In all, the 10,779 citations came from 637 different journals, with 883 of them being journal self-citations. Of the rest,
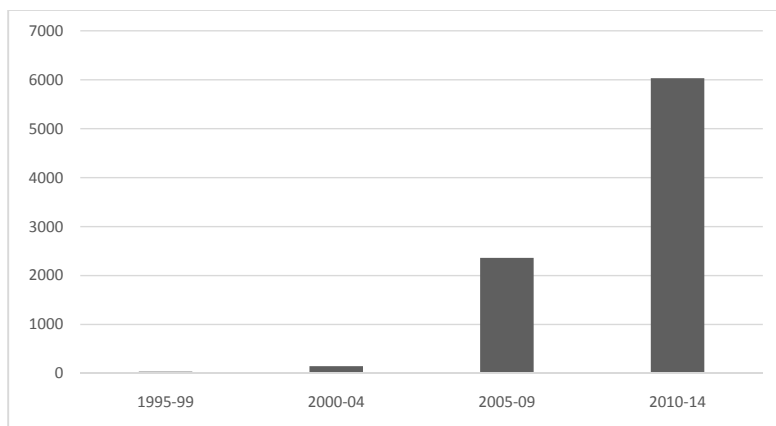
Figure 3. Numbers of citations to articles published in *MATCH* over the period 1995-2014.

the following eleven journals have contributed at least 50 citations: *Journal of Mathematical Chemistry* (205 citations), *Discrete Applied Mathematics* (146), *Linear Algebra and its Applications* (128), *Ars Combinatoria* (93), *Journal of Computational and Theoretical Nanoscience* (91), *Applied Mathematics and Computation* (80), *Optoelectronics and Advanced Materials Rapid Communications* (80), *Studia Universitatis Babes Bolyai Chemia* (65), *Utilitas Mathematica* (59), *Croatica Chemica Acta* (50) and *Digest Journal of Nanomaterials and Biostructures* (50). These journals are hardly unexpected given their respective subject foci but there are also individual citations from sources as disparate as *Water Resources Management* (which cites a *MATCH* article describing a decision support tool) and a chapter in a monograph entitled *State Territoriality and European Integration* (which cites a *MATCH* article on tripartite graphs).

In like vein, one obtains a highly diverse picture when considering the 110 *WoS* subject categories to which these citing articles belong: the largest contributors are as expected (e.g., Chemistry Multidisciplinary, Mathematics Interdisciplinary Applications, Computer Science Interdisciplinary Applications, and Mathematics Applied) but then there are 28 singleton contributions from far less obvious subject categories. For example, an article in the *International Journal of Nursing Knowledge* (in the Nursing category) cites a *MATCH* article describing families of spectra-based descriptors that can be used to

discriminate between molecular graphs; and an article in *Bioresource Technology* (in the Agricultural Engineering category) cites a *MATCH* paper on the comparison of DNA sequences using dinucleotide frequencies of occurrence. Examples such as these make clear that the journal makes intellectual contributions not only to mathematical and computer chemistry but also to the chemical and life sciences more generally.

4 Conclusions

It is clear from the data presented here that the journal *MATCH Communications in Mathematical and in Computer Chemistry* has grown steadily over the two decades between 1995 and 2014. Its constituent articles have attracted citations from publications in a large number of disciplines, thus demonstrating the journal's widespread impact beyond mathematical and computer chemistry.

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Appendix

X. Li,Y. Shi, A survey on the Randic index, *MATCH Commun. Math. Comput. Chem.***59** (2008) 127-156 (109 citations).

R. Ashrafi, A. Loghman, PI index of zig-zag polyhex nanotubes, *MATCH Commun. Math. Comput. Chem.***55** (2006) 447-452 (99 citations).

S. Yousefi, A. R. Ashrafi, An exact expression for the Wiener index of a polyhex nanotorus, *MATCH Commun. Math. Comput. Chem.***56** (2006) 169-178 (81 citations).

A. R. Ashrafi *et al*., Computing PI and omega polynomials of an infinite family of fullerenes, *MATCH Commun. Math. Comput. Chem.* **60** (2008) 905-916 (70 citations).

J. Konc, D. Janežič, An improved branch and bound algorithm for the maximum clique problem, *MATCH Commun. Math. Comput. Chem.* **58** (2007) 569-590 (70 citations).

P. E. John *et al*., *CI* index in tubular nanostructures, *MATCH Commun. Math. Comput. Chem*. **57** (2007) 479-484 (70 citations).

B. Zhou, I. Gutman, Further properties of Zagreb indices, *MATCH Commun. Math. Comput. Chem*. **54** (2005) 233-239 (64 citations).

A. R. Ashrafi, S. Yousefi, Computing the Wiener index of a $TUC_4C_8(S)$ nanotorus, *MATCH Commun. Math. Comput. Chem*. **57** (2007) 403-410 (62 citations).

A. Mauri *et al*., Dragon software: An easy approach to molecular descriptor calculations, *MATCH Commun. Math. Comput. Chem*. **56** (2006) 237-248 (61 citations).

P. R. Duchowicz *et al*., Alternative algorithm for the search of an optimal set of descriptors in QSAR-QSPR studies, *MATCH Commun. Math. Comput. Chem*. **55** (2006) 179-192 (59 citations)