Experimental Mathematics and Exact Computation

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ABSTRACT. The crucial role of high performance computing is now acknowledged throughout the physical, biological and engineering sciences: whether scientific computing, visualization, simulation or data-mining. The emergence of powerful mathematical computing environments, the growing availability of fast, seriously parallel computers and the pervasive presence of the internet allow for (pure and applied) mathematicians to partake of the same tools.

The unique features of our discipline make this both more problematic and more challenging. That said, many of the greatest computational benefits to mathematics are accessible through low-end “electronic blackboard” versions of experimental mathematics [1] and computing. Through a handful of examples, embracing both the high-end and the low-end, I intend to illustrate the opportunities and issues with which I am personally familiar. Many of the more sophisticated examples involve

\[ \zeta(n) = \sum_{k=1}^{\infty} \frac{1}{k^n} \]

and its friends [2] and focus on the use of Integer Relations Algorithms [3,4] – recently described as among the ‘top ten’ algorithms of the century [5].

References


1 All references are available at http://www.cecm.sfu.ca/preprints/.