

Outgrowths of the Digital Library of Mathematical Functions Project

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In 2010, the Applied and Computational Mathematics Division of the National Institute of Standards and Technology published the NIST Handbook of Mathematical Functions (Cambridge University Press) and released the online NIST Digital Library of Mathematical Functions (dlmf.nist.gov). These two new sources of mathematical reference data subsume and greatly expand the coverage of the best-selling 1964 Handbook of Mathematical Functions (Abramowitz and Stegun, eds.).

Mathematicians, and users of mathematics, are using online resources whenever possible, and the online DLMF is providing free access to validated reference data for special functions and orthogonal polynomials. NIST is committed to maintaining and improving the DLMF as well as developing additional online capabilities in these fields. Currently two projects are under way.

The Digital Repository of Mathematical Formulae (DRMF) Project was initiated recently as an outgrowth of discussions begun among members of the SIAM Activity Group on Orthogonal Polynomials and Special Functions in 2011. Its purpose is to provide a Wikipedia-style framework in which published mathematical reference data is translated into an online setting. The prototype DRMF site (gw32.iu.xsede.org) contains the Zeta and Related Functions chapter from the DLMF and has gained permission to add, for example, data from Koekoek, Lesky and Swarttouw's Hypergeometric Orthogonal Polynomials and Their q -Analogues. DRMF users are invited to insert comments, for example proofs or references to proofs, which are not always provided in the published sources. In contrast, every mathematical statement in the DLMF was validated by engaging an independent reviewer to verify the original author's work. However, the DLMF provides users only with an indirect feedback capability via email.

The idea of the DLMF Tables Project is to allow users to generate on demand numerical tables of special functions that are provably accurate to the specified precision. This idea was conceived at NIST years ago but was impractical at the time because of mathematical, computational and information technology considerations. The prototype DLMF Tables site (dlmftables.uantwerpen.be) generates a small interval enclosure for each requested function value. The interval endpoints are computed to somewhat higher precision (number of decimal places) than the requested precision, enough to permit accurate rounding in the great majority of cases. In addition to displaying the interval enclosure, the site gives the user the option of displaying round to nearest, round up (toward infinity), round down (toward negative infinity), round toward zero, and round away from zero. This work is joint with the Department of Mathematics and Computer Science, University of Antwerp, Belgium.