

LibmCS: a Standard Compliant & Pre-Qualified Mathematical Library

An IEEE-754, ISO C18, POSIX, and MISRA C:2012 compliant and ECSS category B pre-qualified math library for critical systems

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Abstract

Mathematical libraries are used in nearly any flight software and in particular in AOCS/GNC systems and scientific algorithms. The common practice to manage the mathematical functions in a flight software project is to isolate well known and established functions and to characterize these functions with respect to input ranges, errors, and performance. This practice doesn't typically cover corner cases where some of these functions might reveal an unexpected behavior in terms of accuracy or timing. Further, most of the projects happen to re-qualify the mathematical library for each new project again. Some of these aspects were covered by the precursor of this activity, which produced the MLFS mathematical library. This library solved the problem for a subset of the mathematical functions required by the applicable standards (IEEE-754, ISO C, and POSIX) but the problem of seamlessly integrating the library into other existing COTS software components used in space software and the long term maintenance and evolution options of the library were not addressed.

The Mathematical Library for Critical Software (LibmCS) provides a standard compliant mathematical library (`libm`) which is pre-qualified to ECSS Category B. It minimizes project specific integration and delta-qualification efforts for this building block and guarantees its long term maintenance.

The LibmCS can already be qualified for ESA missions. Further activities will aim at an ECSS Category A qualification of the LibmCS and adapting the library algorithms to take advantage of new processor architectures.

Keywords: Mathematical library, `libm`, qualified, ECSS, critical systems, standard compliant
