

A Matlab/Octave toolbox for the computation of Bessel/Hankel functions with large complex order

Zoïs MOITIER

April 20, 2022

Abstract

We code a Matlab/Octave toolbox to compute the Bessel and Hankel functions with large complex order.

1 How to use the toolbox

It is governed by the CeCILL-C license under French law and abiding by the rules of distribution of free software. It can be used, modified and/or redistributed under the terms of the CeCILL-C license as circulated by CEA, CNRS and INRIA at the following URL: <http://www.cecill.info>.

The goal of the toolbox is to compute the Bessel functions J_ν/Y_ν and the Hankel functions $H_\nu^{(1)}/H_\nu^{(2)}$ when the order ν is a large complex number in modulus. The main functions of the toolbox are:

Function	How to call it.
$J_\nu(z)$	<code>J = besselj_cplx(v, z)</code>
$J'_\nu(z)$	<code>Jp = besselj_p_cplx(v, z)</code>
$Y_\nu(z)$	<code>Y = bessely_cplx(v, z)</code>
$Y'_\nu(z)$	<code>Yp = bessely_p_cplx(v, z)</code>
$H_\nu^{(1)}(z)$	<code>H1 =esselh_cplx(v, 1, z)</code>
$H_\nu^{(1)'}(z)$	<code>H1p = esselh_p_cplx(v, 1, z)</code>
$H_\nu^{(2)}(z)$	<code>H2 = esselh_cplx(v, 2, z)</code>
$H_\nu^{(2)'}(z)$	<code>H2p = esselh_p_cplx(v, 2, z)</code>

Table 1: Link between Bessel/Hankel functions and their name in the code.

The implementation is base on uniform asymptotic expansions for large order as describe in [1]. For now, we should expect good accuracy for $|\nu| \geq 20$.

References

- [1] N. M. Temme. Numerical algorithms for uniform airy-type asymptotic expansions. *Numerical Algorithms*, 15(2):207–225, 1997. [doi:10.1023/A:1019197921337](https://doi.org/10.1023/A:1019197921337).