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Problems and Solutions in Efficient, Accurate Computation of the Airy Functions in the Complex Plane. Preliminary report.

Airy functions of complex variable are used as basis functions for solutions of the wave equation in layered media, such as lens coatings, ground penetrating radar, and hydroacoustical propagation in the ocean. This requires efficient, accurate computation of the Airy functions Ai(z) and Bi(z) over a large region of the complex plane. Algorithms that use a combination Pade approximants based expansions in z and 1/z can provide such an algorithm. These expansions in 1/z have a branch cut that isn't documented in the literature because the step across it has a magnitude that is on the order of the best accuracy of the asymptotic expansion when used as a series. High accuracy computations along the branch cuts can be accomplished by using the small argument expansion out to a magnitude of z so that the magnitude of the step is less than the required accuracy. For the Airy function Ai(z), the branch cuts are along exp(j*(pi/6)+k*pi/3)) and small argument expansions can be extended so that demonstrable accuracy can be achieved to high accuracy. For its companion function Bi(z) the branch cuts are along exp(j*k*pi/3) which includes the positive real axis, and a satisfactory solution for certain regions along these branch cuts is difficult. (Received September 19, 2007)