Accurate computation of boundary integrals for nearly touching interfaces

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Boundary integral (BI) methods are among the most popular methods for computing interfacial fluid flow, and have the advantage that they can be made high-order accurate. Thus, they are useful for investigating phenomena that require high accuracy to resolve features, such as “pinching” or topological singularities that can occur on the interface. However, standard BI methods lose accuracy when two parts of an interface are near touching. This is due to the need to evaluate boundary integrals with nearly singular kernels in complicated domains. In this talk, we present a new method for the accurate computation of boundary integrals with singular or nearly singular kernels in 3D. Our method is based on the QBX method of Klockner et al., but with several key ideas to simplify its implementation and improve its efficiency. We give error estimates for our method, and illustrate its performance in several examples. This work is joint with Anna-Karin Tornberg.