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Boundary Integral Treecode (BIT) as a sub-cell method in Particle-In-Cell (PIC)[1] ANDREW CHRISTLIEB, Michigan State University, KEITH CARTWRIGHT, AFRL/RDHE — The Boundary Integral Treecode (BIT) is a method for computing long-range forces in $O(N \log N)$ without making use of an underlying mesh. The method use the point cluster form of fast summation. BIT has been shown to exhibit less numerical heating with higher accuracy than PIC and has been recently proposed as a sub-cell method in PIC as a way of extending efficient legacy PIC codes to dense plasma problems, where numerical heating is a challenge. The idea is that sub-cell BIT can extend PIC by circumventing the need to follow the traditional rule of thumb of $\Delta x < \lambda_D$, which controls numerical heating in traditional explicit PIC codes. This has been demonstrated in 1D periodic test problems. To use high order explicit time stepping, BIT and BIT corrected PIC use a regularized force kernel. In the work on BIT corrected PIC, the regularization was found to have a negative impact near boundaries. To overcome this issue, a systematic approach to localization of the kernel, based on Taylor expansions, and rigorous error bounds for the error near a boundary were developed. This paper discusses the extension of BIT and BIT corrected PIC to non- periodic domains through the use of adaptive regularization to control the error near boundaries. The 1D virtual cathode problem is investigated.

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