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The Method of Reflections

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The method of reflections was invented to obtain approximate solutions of the motion of more than one particle in a given environment, provided that one can represent the solution for one particle rather easily. This motivation is quite similar to the motivation of the Schwarz domain decomposition method, which was invented to prove existence and uniqueness of solutions of the Laplace equation on complicated domains, which are composed of simpler ones, for which existence and uniqueness of solutions was known. Like for Schwarz methods, there is also an alternating and a parallel method of reflections, but interestingly, the parallel method is not always convergent. I will carefully trace the historical development of the method of reflections, give several precise mathematical formulations,
an equivalence result with the alternating Schwarz method for two particles, and also an analysis for a one dimensional model problem with three particles of the alternating, parallel, and a more recent averaged parallel method of reflections. This will reveal that the method of reflections for more than two particles is fundamentally different from the Schwarz method.

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