On the modified conjugate gradient method in cloth simulation

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Abstract: A lot of recent attention has been paid in the computer graphics community to the subject of realistic cloth simulation. The seminal paper on cloth simulation by Baraff & Witkin (1998) presents a particle model and an algorithm for solving certain large, sparse systems of linear equations. Such systems arise when employing implicit time integration methods in an effort to achieve large step cloth simulation in the presence of constraints. For this puspose a modified preconditioned conjugate gradient (MPCG) algorithm was proposed. Essentially, a filtering procedure is applied to the usual preconditioned conjugate gradient algorithm.

However, no proof of convergence for this MPCG algorithm was available. In order to furnish such a proof we recast the algorithm into a linear algebra setting, identifying the filtering procedure as an orthogonal projection. This leads not only to a convergence proof but also to a correction in the initiation stage of the original algorithm. We give an example to illustrate the performance improvement offered by this correction.