Maintaining the Convex Hull of a Set of Points Moving in $\mathbb{R}^3$
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Intuitively speaking, the convex hull of a set of points in $\mathbb{R}^3$ can be imagined as taking a large piece of plastic wrap and stretching it all around the exterior of the points. Assuming the set of points is non-degenerate, each facet of the convex hull is defined by three points (degenerate cases can be handled by standard perturbation arguments). Of course, more formal definitions can be found all over the web, as well as in such textbooks as *Computational Geometry* by M. deBerg et. al..

One problem with creating a kinetic data structure for maintaining the convex hull of a set of moving points in $\mathbb{R}^3$ seems to be locality. If one exterior point moves towards the inside of the set of points, a whole new convex hull may have to be computed for that region, a computation which may possibly involve a large number of points.

Sources found online that may provide some insight:

- `http://graphics.stanford.edu/projects/lgl/papers/g-mm-04/g-mm-04.pdf`
  This paper from Guibas describes maintaining the 2D Convex Hull of points moving in the plane. In it he poses this open problem, saying, "No comparable structure is known for the convex hull of points in dimension $d \geq 3$."

- `http://www.aladdin.cs.cmu.edu/reu/mini_probes/2005/dyn_kin.html`
  This REU student seems to have taken a stab at the problem, but I'm not thoroughly convinced that he produced general results.

- `http://www.cs.uwaterloo.ca/~tmchan/dch3d_soda.ps`
  The paper from Timothy Chen at SODA 2006 which describes very recently developed methods to insert/delete points into a 3D Convex Hull dynamically. It is possible that this result can be extended to points moving in the plane.

- `http://www.tem.uoc.gr/~mkaravel/papers/spanners.ps`
  This paper on spanners seems to deal with maintaining "relative" convex hulls, that is when the entire structure is contained within a polygon. It may be possible to change the method such that it doesn't need to rely on the exterior polygon.

- `http://biogeometry.duke.edu/software/coreset/`
  Software from Sariel et. al., which computers a Kinetic Convex Hull Approximately. At the bottom of the page, it includes links to three publications which talk more about the theory behind using coresets in kinetic data structure approximations.