# An Efficient Algorithm for Identifying Objects Using Robot Probes

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## Abstract

A problem being studied in robotics is that of identifying objects or determining object shapes using robot probes. Given a convex planar $n$-sided object, $3n-1$ probes are necessary and $3n$ are sufficient to determine the shape of the $n$-gon. The problem of identification is different. Given a set of $m$ convex $n$-gons, $2n+1$ probes are sufficient to identify one of the objects.

We present a strategy for identifying an object from a set of $m$ convex $n$-sided objects with a fixed orientation. An algorithm that performs some preprocessing on the objects and takes $O(mn)$ time is described. We then present a probing scheme that uses the results from the preprocessing algorithm to identify an object from the set using no more than $m-1$ probes in $O(m)$ time. These probes can be aimed at the object one at a time in any order or in parallel. We also describe two algorithms, Add Object and Delete Object that are used when the set of objects is updated. Add Object computes a new probe direction, if necessary, when an object is added to the set and takes $O(m+n)$ time. Delete Object deletes a probe direction, if necessary, when an object is removed from the set and takes $O(m)$ time.