Extracting Straight Lines from Tracked Pixels

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Curve Splitting

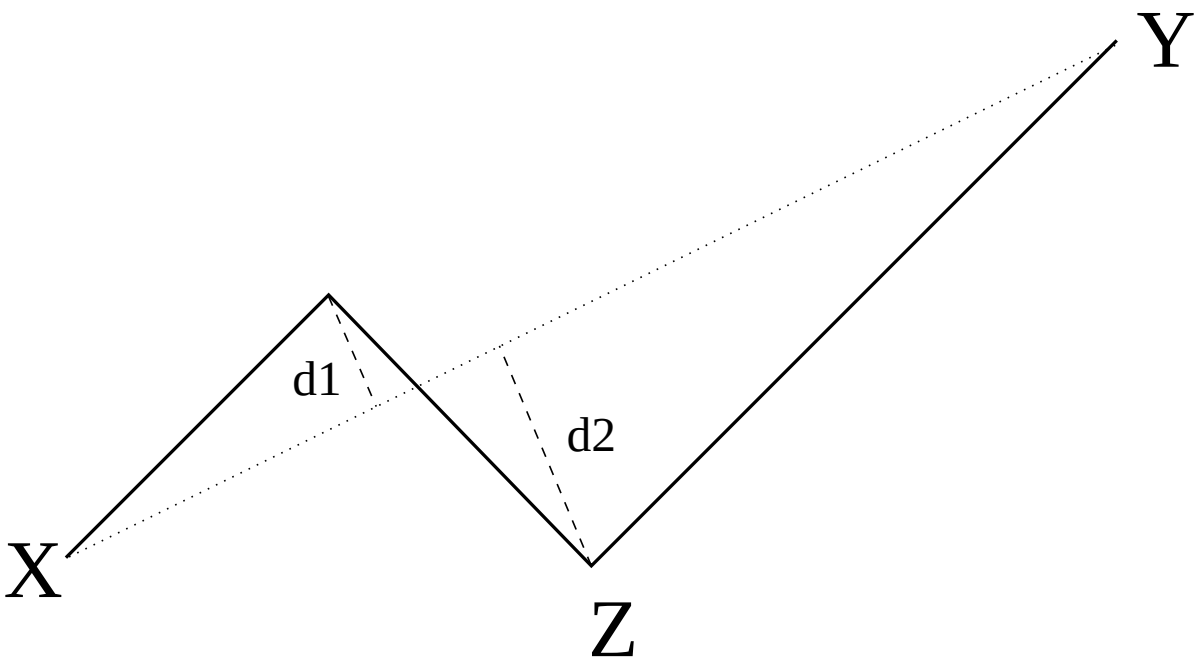
Given a set of consecutive pixels on the perimeter of an object, how do we find straight line segments?

Gives a more compact representation

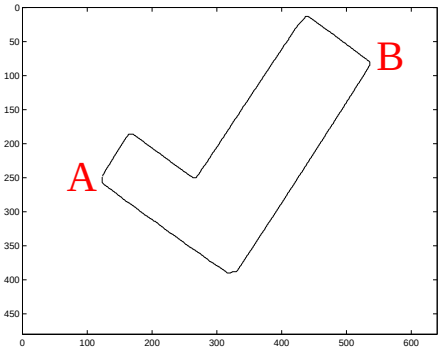
Ignore curved boundries - more advanced techniques exist

A well known recursive splitting algorithm

Recursive Splitting Algorithm



Recursive splitting the boundary into linear segments



1. Find leftmost point A
2. Find rightmost point B
3. Split points in set A− >B and B− >A:
   (a) Find line thru current segment endpoints X & Y
   (b) Find point Z furthest from the line at distance d
   (c) If d is less than a threshold, then this segment finished
   (d) Otherwise, create new sets X− >Z and Z− >Y and recurse

Recursive Splitting Code

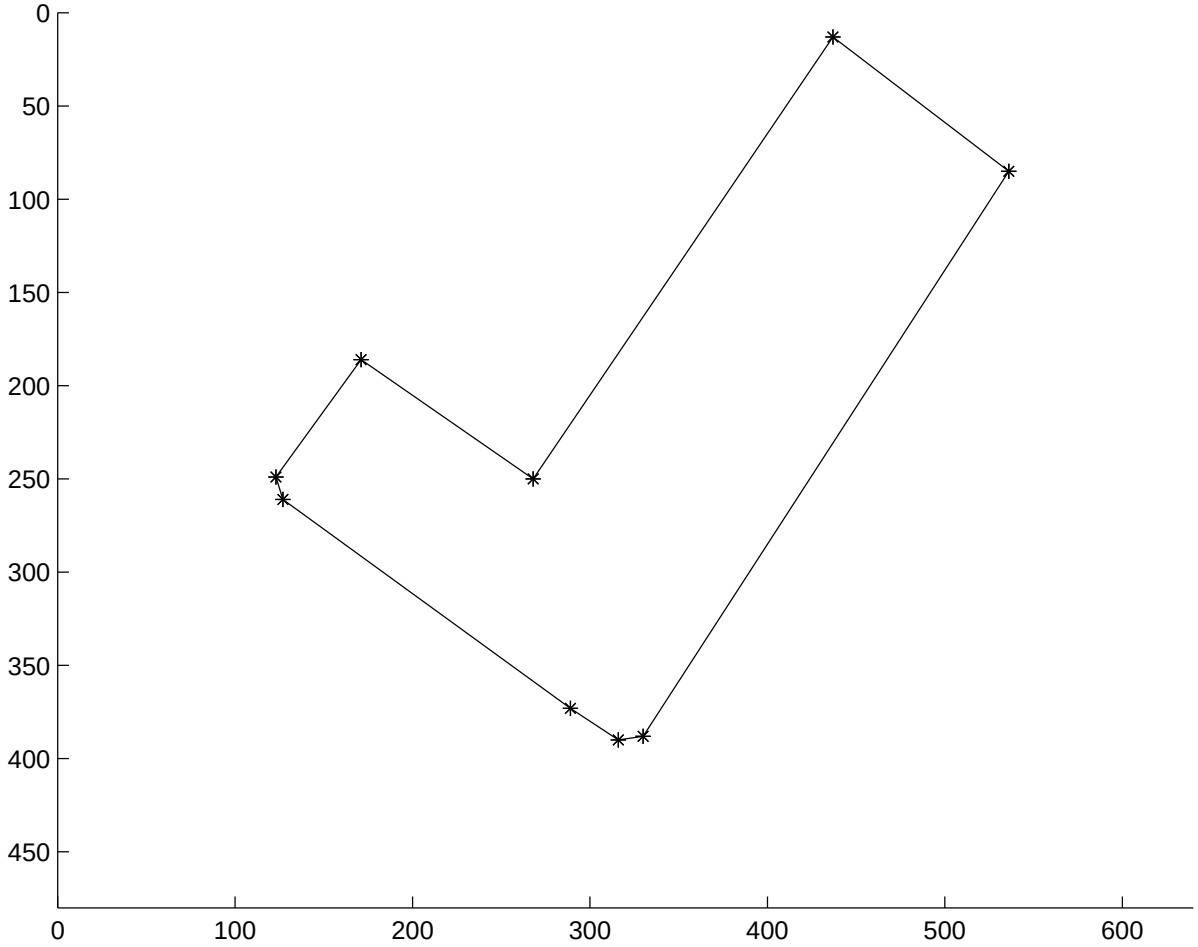
```
function recsplit(r,c,threshold)
  global numlines lines
  n = length(r);          % total number of points
  vec = [c(n)-c(1), r(1)-r(n)];  % unit vector
  vec = vec/norm(vec);           % perpendicular to XY

  % find point furthest from line
  maxdist = 0;
  for i = 1 : n
    dist = abs( [r(i) - r(1), c(i) - c(1)] * vec' );
    if dist > maxdist
      maxdist = dist;
      maxindex = i;             % where furthest
    end
  end
```

```
% check for splitting by testing maximum point distance
if maxdist < threshold
  % then it's a single line - save it
  numlines = numlines + 1;
  lines(numlines,1) = r(1);
  lines(numlines,2) = c(1);
  lines(numlines,3) = r(n);
  lines(numlines,4) = c(n);
else
  % otherwise it needs to be split up
  recsplit(r(1:maxindex),c(1:maxindex),threshold);
  recsplit(r(maxindex:n),c(maxindex:n),threshold);
end
```

Splitting Results

Segmented boundary:

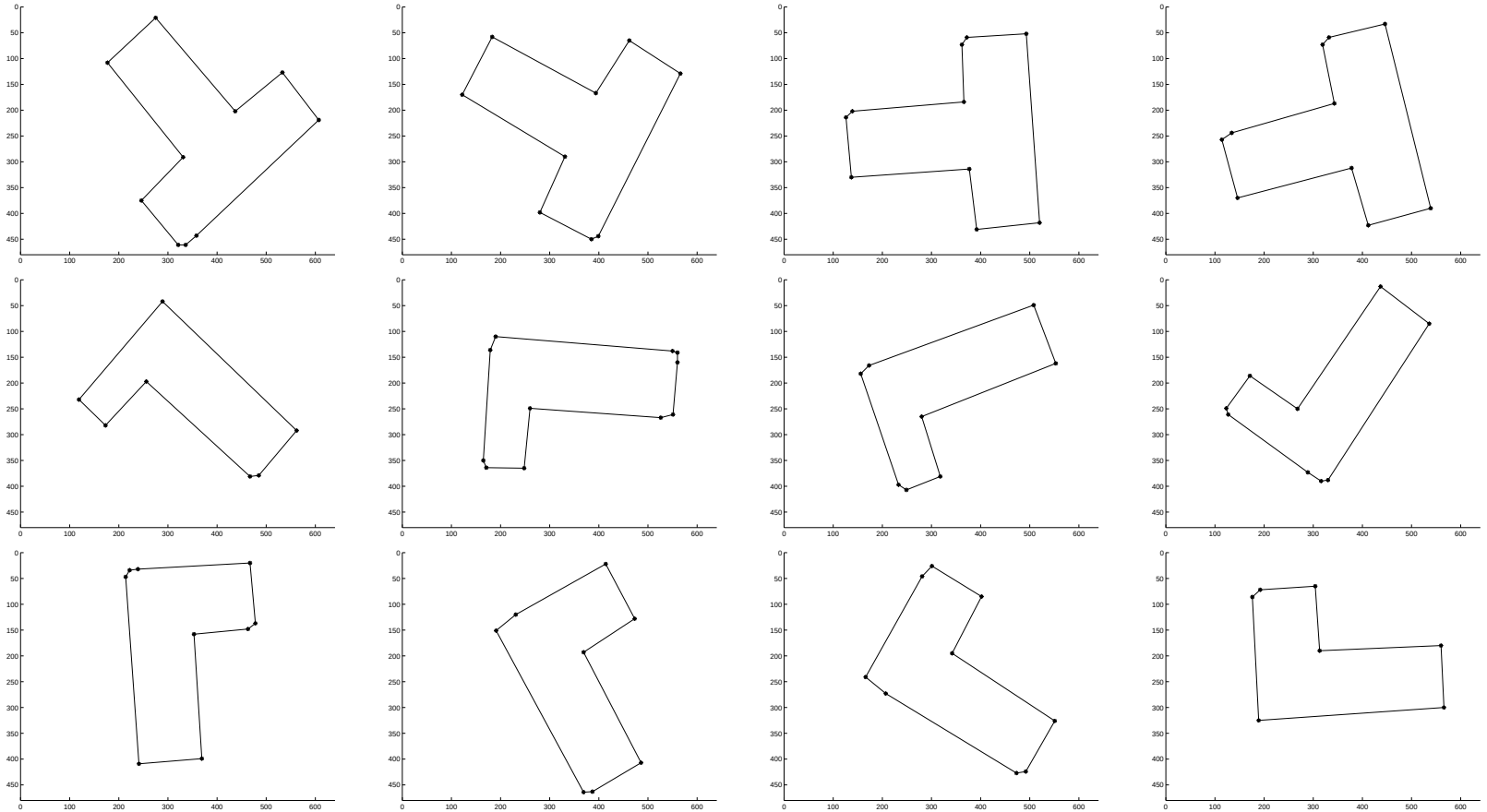


Describing Lines

Endpoints	Length	True Length
(249,123)-(261,127)	13	-
(261,127)-(373,289)	197	247
(373,289)-(390,316)	32	-
(390,316)-(388,330)	14	-
(388,330)-(85,536)	366	371
(85,536)-(13,437)	122	124
(13,437)-(250,268)	291	294
(250,268)-(186,171)	116	124
(186,171)-(249,123)	79	77

Input into matcher: extra lines, short lines, longer lines

Full Result Set



Discussion

1. Simple boundary segmentation process
2. Gives compact line-based description
3. May have some extra segments
4. Segments may be too long or short

What Have We Learned?

Introduction to

- Curve segmentation

From pixels to descriptions