

On Three Constrained Versions of the Digital Circular Arc Recognition Problem

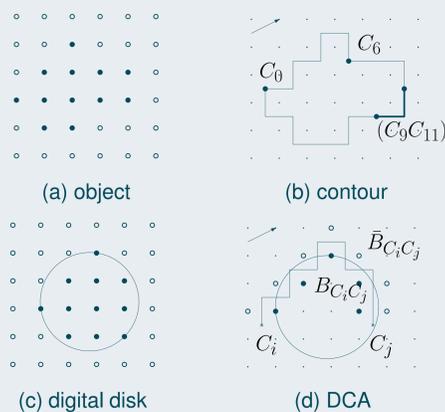
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Abstract

We propose a simple and linear-time algorithm for solving three subproblems : online recognition of digital circular arcs coming from the digitization of a disk having either a given radius, a boundary that is incident with a given point, or a center that is on a given straight line. Solving these subproblems is interesting in itself, but also provides a way for segmenting digital curves into digital circular arcs (DCAs).

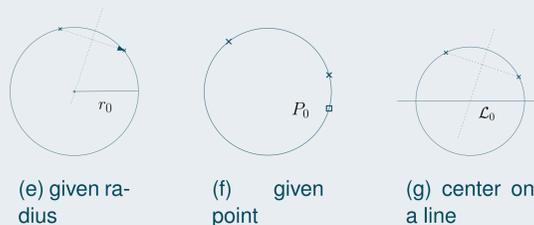
Data



Problem

Computing the parameters of the set of Euclidean disks $\mathcal{D}(\omega, r)$ separating $B_{(C_i, C_j)}$ from $\bar{B}_{(C_i, C_j)}$, such that $r = r_0$ (e), \mathcal{D} touches a fixed point P_0 (f), ω belongs to a fixed straight line \mathcal{L}_0 (g).

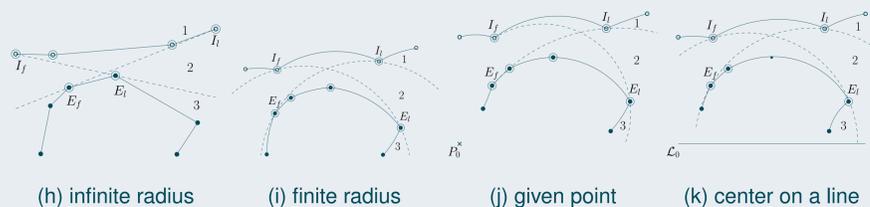
Three classes of constrained disks :



Method

- A *point of support* is a point of $B_{(C_i, C_j)}$ or $\bar{B}_{(C_i, C_j)}$ that is located on the boundary of a constrained disk separating $B_{(C_i, C_j)}$ from $\bar{B}_{(C_i, C_j)}$.
- The inner (resp. outer) *circular hull* of a sequence of points L is a subsequence of L such that, for each pair of consecutive points, all the points of L belong (resp. do not belong) to the constrained disk defined by the two points.
- The points of support of $B_{(C_i, C_j)}$ (resp. $\bar{B}_{(C_i, C_j)}$) are *consecutive points* of the inner circular hull of $B_{(C_i, C_j)}$ (resp. outer circular hull of $\bar{B}_{(C_i, C_j)}$).
- The separating constrained disks are implicitly described by the points of support.

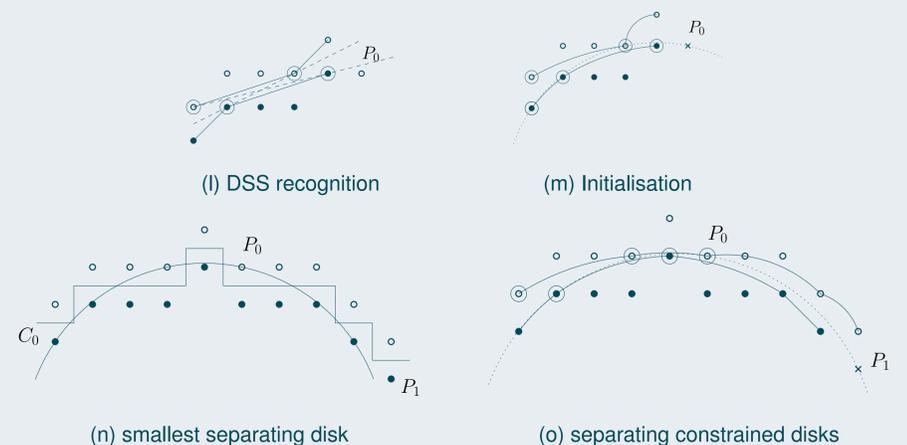
Computation of the separating constrained disks



Online computation :

- black point in area 1 or white point in area 3 : stop, there is no separating constrained disks.
- black point in area 3 or white point in area 1 : ok, nothing to do.
- black point or white point in area 2 : ok, update of the circular hulls and update of the points of support.

DCA recognition



Results



Conclusion

- Simple, online, linear-time algorithm.
- Integer-only computations.
- Can be used to fastly segment a digital curves into digital circular arcs.