

Optimal Reduction of a Rectangular Region

This problem is proposed by A. Lina (R&D manager of the *Imaging Software Processing Group* at Matrox) and S. Chapleau (responsible for the development of computer vision algorithms in the *Imaging Software Processing Group* at Matrox). One must solve analytically a problem in geometric optimization, namely the optimal reduction of a rectangular region that intersects a given rectangular domain. Several optimality criteria will be considered.

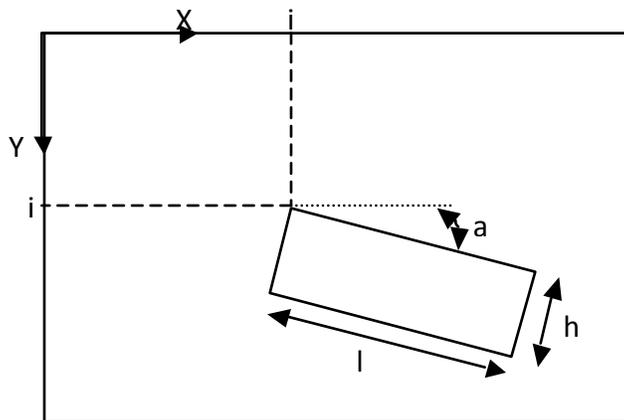
Introduction

Many image processing tasks must be performed within a given region of the image, either because one wants to remove the influence of the information contained in the image as a whole, or one wants to perform the task quickly by restricting it to a domain smaller than the original one. The rectangular region is undoubtedly the most widespread geometrical shape, on account of its simplicity and ease of implementation within the computer memory. The demand for more complex shapes, however, is increasing, because of some image analyses that require a greater flexibility. Note that the simple shapes already present us with interesting challenges...

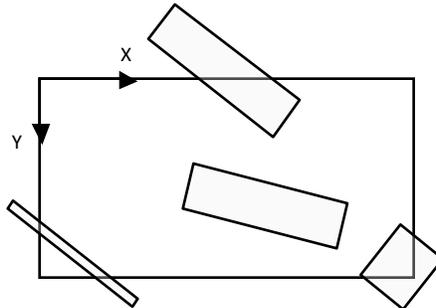
Tilted rectangular region

A tilted rectangular region is defined by

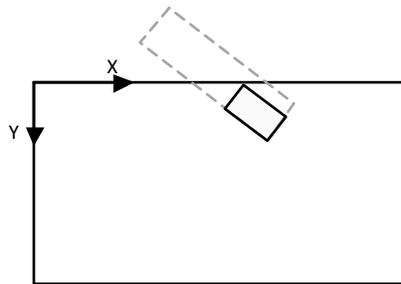
- the position (i, j) of its upper left corner,
- its height (denoted h),
- its width (denoted ℓ), and
- the angle (denoted a) between the “wide” side of the rectangle and the x -axis of the image.



The tilted rectangular region may have any dimensions or angle (with respect to the x -axis). It may be partially contained within the image or contain the entire image (among other configurations). All possible intersections between the region and the image are allowed!



The region reduction consists of determining the best rectangle of angle a included in the original rectangle **and** the image.



Proposed problem

Within the framework of the workshop, we pose the challenge of describing analytical solutions or geometric constructions for finding an optimal reduction of the tilted rectangular region. Several optimality criteria may be considered. Here are three of them.

- A reduction that maximizes the area.
- A reduction that maximizes the height.
- A reduction that maximizes the width.