Problem Statement
The problem of labeling the connected components (CCL) of a binary image is well-defined and it is a fundamental task in image processing and computer vision applications. Most of recent proposals exploit a scan mask to perform CCL and focus on performance optimization making use of optimal decision trees that allow a reduction of memory accesses.

Goals:
1) Improve the speed of CCL taking into account image patterns occurrences and altering optimal decision trees;
2) Speed up CCL operations using parallelization.

Modeling of Decision Trees with Patterns Frequencies

Creation of an optimal decision tree: if two branches lead to the same action, the condition from which they originate may be removed. This conversion can be geometrical interpreted as the partitioning of an n-dimensional hypercube where the vertexes correspond to the $2^n$ possible rules. Associating to each condition removal a unitary gain we can select the tree which maximizes the total gain and thus minimizes the number of memory accesses.

Idea: We calculate the occurrence frequencies of all possible mask patterns in a reference dataset. Then, considering as gain of a condition removal the frequencies of associated patterns, it is possible to generate new optimal decision trees, further reducing the total number of memory accesses.

Parallel Connected Components Labeling

Idea: Improving the performance of existing algorithms employing parallelization.

Solution proposal:
- Divide image into stripes;
- Compute first scan on each stripe (in parallel);
- Merge border labels;
- Compute second scan (in parallel);

Results show that the speed up obtained with two threads on SAUF is ×1.5 in average and it increases up to ×4 on random dataset when 12 threads are involved. BBDT shows a greater speed up with low number of threads (i.e. ×1.7 with 2 threads, up to ×4.7 on random dataset with 8 threads).