Events-based Image Analysis
for Machine Vision and Digital Photogrammetry.

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Any certain engineering technique can be considered as a combination of "*method*" and "*state of art*". Here, "method" is a regular part of technique that to be the best for a common class of problems involved. In the contrary, the term "state of art" means the that part of technique that reflects the peculiarity of the concrete problem and due to this - the skill of the developer. It is very attractive to define the common method for the most wide spectrum of problems, prove its' optimality and then concentrate on the state of art only.

From this point of view, the *model-based image analysis* seems to be suitable enough to apply the common state of problem and, consequently, common "method" to all its concrete problems. The basic state of art here is connected with a choice of the adequate model.

For a measurement of artificial objects some object models (of different types) are developed, and the proper measurement presumes the estimation of numeric parameters of these models. So, the detection methods based on such models to be preferred. However, though some of model-based detectors are developed, usually they contain the heuristic matching procedures without any of optimal assumptions. Because of this reason, most powerful and robust of object detection techniques do match the sample images but not the models.

In our earlier works our group intensively used two of well-known matching techniques: the *Pytiev Morphology* and the *Hough Transform*. The Pytiev Morphology provides the invariant detection of objects by their samples, but it is hard enough in the computational sense and can not work with models. The Hough transform and the Generalised Hough Transform can support the efficient and sophisticated contour analysis, but do not use the intensity information contained in the greytone images. For a model-based object detection, the common "method" called the "*Events-based Image Analysis*" was developed that composes the Pytiev's optimal state of problem and the methodology of Hough transform.

The essential points of this approach are the following:

- The three parts of model are taken in account: object model, registration model and corruption model. The image of object is presumed to be produced from the model by the actualisation, transformed in the regular manner according to the registration model and then randomly corrupted in the limits of the corruption model.
- Real images to be analysed are considered as the sources of events generated by the procedures of low-level image processing.
- The Bayesian theorem or its' fuzzy analogies must be the fundamental basis of the events' analysis. The unknown (as a rule) parameters of probabilistic model are used as the internal parameters of algorithm tuning. The easy way for a corruption account is provided here.
- The Hough-like accumulation methods can be applied to implement the Bayesian estimation of the parameters of registration model.
- The modular separation of detection procedures is naturally available for the case of complex hierarchical models of objects.
- The uniform and very efficient way is provided for the fusion of non-homogeneous information about objects: intensity and contour, 2D and 3D, multispectral, multisensor and so on.

The efficiency of such algorithms mainly depends on the four factors: choice of object model, choice of events to be analysed, selection of parameter space and right interpretation of the events' importance. In other words, these points are make up the "state of art" for "method" proposed.

This approach can be considered as a generic meta-algorithm that supports the creation of the proper model-based detection algorithms for certain types of objects. A lot of examples of such proper algorithms are discussed applying to the proper problems of machine vision and digital photogrammetry.