Features extraction and tracking for visual servoing purpose

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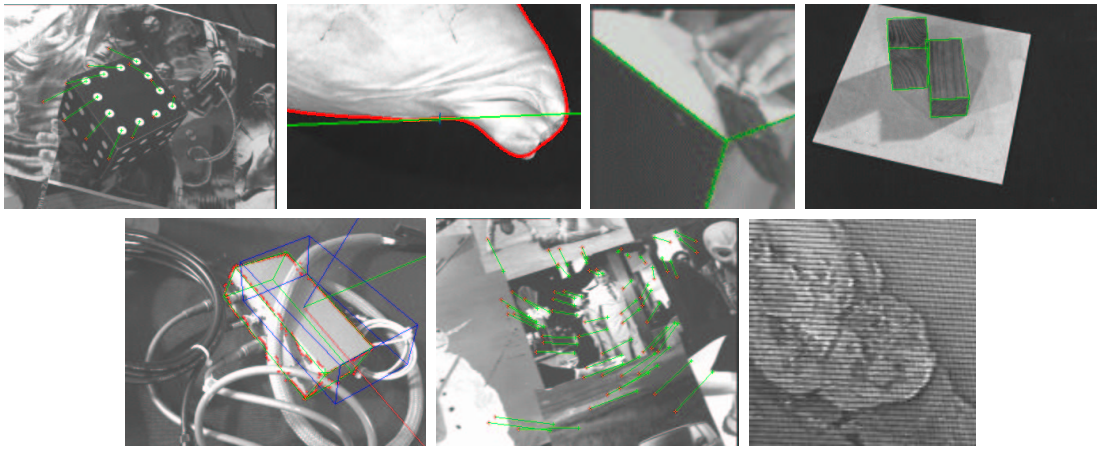

Some examples of scenes considered in visual servoing experiments (ordered using a subjective increasing complexity)

Elaboration of objects tracking algorithms in image sequences is an important issue for research and application related to visual servoing and more generally for robot vision. A robust extraction and real-time spatio-temporal tracking process of visual cue is indeed one of the keys to success, or to failure, of a visual servoing task. To consider visual servoing within large scale applications, it is now fundamental to consider natural scenes without any fiducial markers and with complex objects in various illumination conditions. From a historical perspective, the use of fiducial markers allows the validation of theoretical aspects of visual servoing research. If such features are still useful to validate new control laws, it is no longer possible to limit ourselves to such techniques if the final objectives are the the transfer of these technologies in the industrial world. In this paper we give an overview of a few tracking algorithms developed for visual servoing experiments at IRISA-INRIA Rennes.

Most of the available tracking techniques can be divided into two main classes: feature-based and model-based. The former approach focuses on tracking 2D features such as geometrical primitives (points, segments, circles, ...), object contours, regions of interest ... The latter explicitly uses a model of the tracked objects. This second class of methods usually provides a more robust solution (for example, it can cope with partial occlusion of the objects). If a CAD model is available, tracking is closely related to the pose computation problem and is then suitable for any visual servoing approach. The main advantage of the model-based methods is that the knowledge about the scene (the implicit 3D information) allows improvement of robustness and performance by being able to predict hidden movement of the object and acts to reduce the effects of outlier data introduced in the tracking process. Another approach may also be considered when the scene is too complex (due, for example, to texture, to the lack of specific object, etc.). It is not based on features extraction and tracking as in the two other cases but on the analysis of the motion in the image. 2D Motion computation provides interesting information related to both camera motion and scene structure that can be used within a visual servoing process.

This paper will be organized as follow: in a first part we will recall basic features extraction and tracking algorithms that are classically considered in visual servoing. In a second part, model-based algorithms will be presented for the tracking of 3D objects. Finally we will show how dominant motion computation may be used in dynamic visual servoing approaches.