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Cognitive Robotics

Autonomous Visual Tracking Algorithms

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May 12, 2004

1. Problem Formulation

This paper describes an algorithm for autonomous visual tracking of a moving object. The algorithm is designed for a multi-vehicle surveillance system that includes a UAV and a ground rover. A typical mission scenario of such system is depicted in Figure 1. Visual coverage of the rover from the UAV is done in order to facilitate remote operation of the rover and to facilitate obstacle detection by the rover (as ground rovers, using their forward-looking cameras, are not very good at the detection of obstacles below

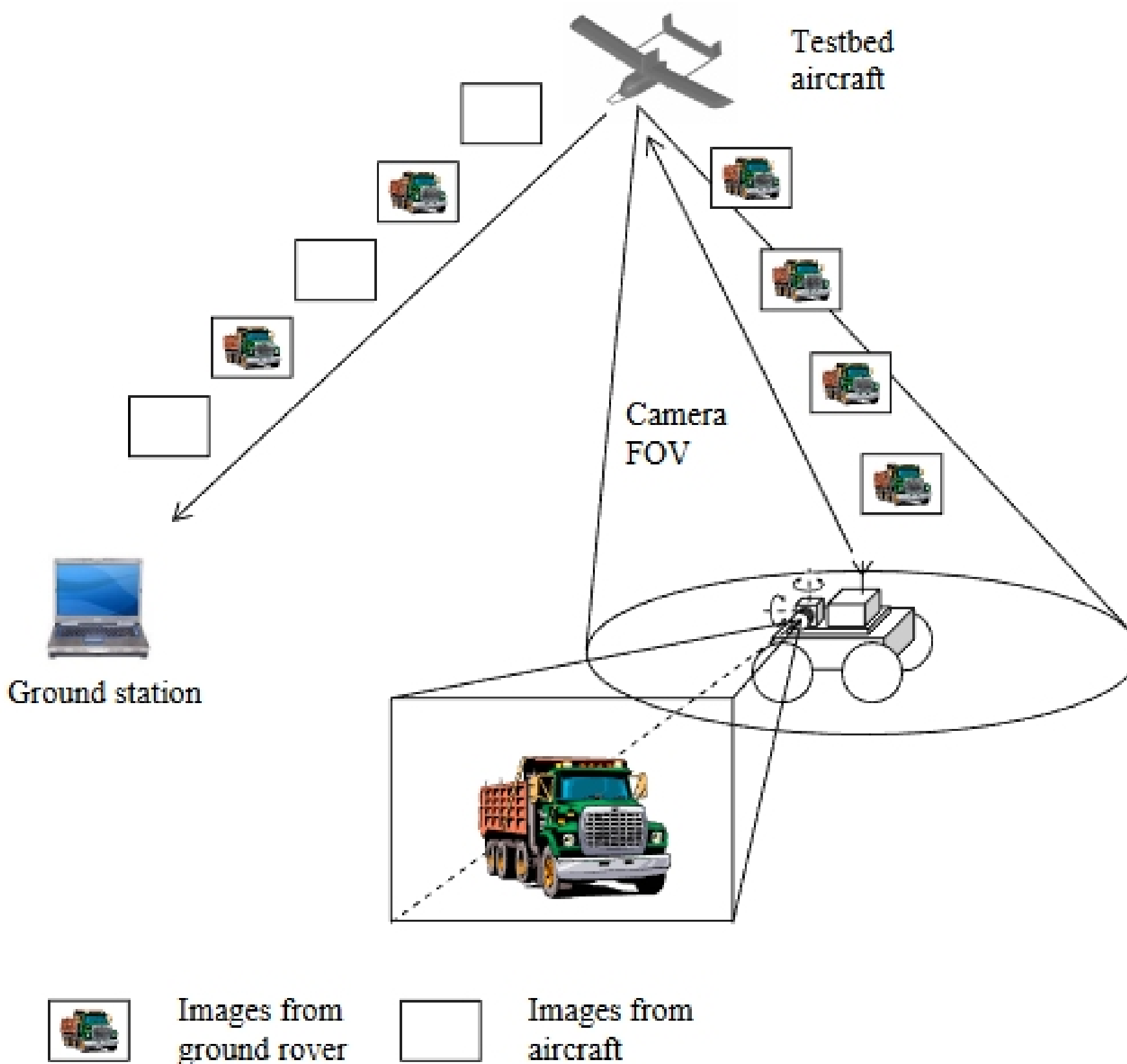


Figure 1: Mission scenario

ground level such as holes in the ground, and additional visual coverage from an aircraft allows to alleviate detection of such obstacles). At the same time, rover provides visual tracking of different objects on the ground. Both the aircraft and the rover are equipped with pan/tilt/zoom cameras.

General approach to the design of the control system is shown in Figure 2.

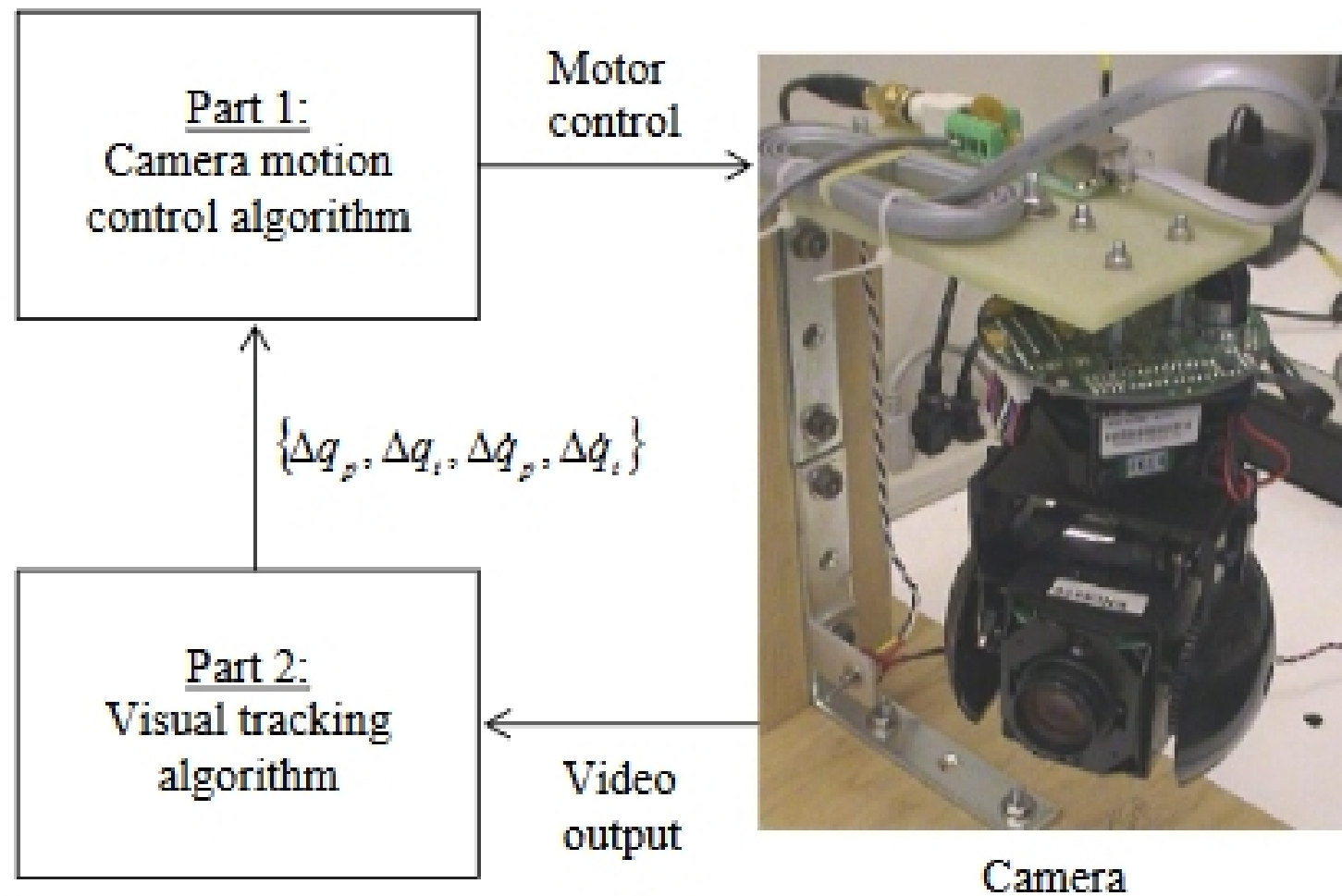


Figure 2: Control algorithm

The control algorithm will consist of two parts. Part 1 will generate control signals for the camera's motors, while part 2 will be doing visual tracking of a moving object in the field of view of the camera. The output of part 2 will consist of values of $\Delta q_p, \Delta q_t, \Delta \dot{q}_p, \Delta \dot{q}_t$, which are error signals of the pan and tilt angles of the camera and their rates of change, which will be used as an input to part 1 of the algorithm.

Before solving the objective problem depicted in Figure 1, a simplified version of the problem is considered. The experimental setup used in the simplified version of the problem is shown in Figure 3. Pan/tilt/zoom camera is mounted on the ceiling of a room, while the rover moves on the floor of the room. The problem for the camera is to do visual tracking of the rover.