3d stereo reconstruction of train paths for supporting maintenance operations

Massimiliano Nitti, Nicola Mosca, Vito Reno, Patruno Cosimo, Maria diSumma, Roberto Colella, and Ettore Stella
Institute of Intelligent Industrial Systems and Technologies for Advanced Manufacturing, CNR, Italy
(massimiliano.nitti@cnr.it)

Railway infrastructure maintenance is a critical activity for ensuring safe train operations, due to the constant mechanical stress and wear and tear that crucial parts of the infrastructure such as rail and catenary undergo under use. Several methodologies and systems have been devised for diagnosing and prevent anomalies and minimize safety risks, that measure geometrical parameters and assess the way the infrastructure interacts with the train. While those techniques help at identifying anomalies when they occur, sometimes they are not able to provide enough evidence on the reasons behind the failure. A visual inspection can surely help in assessing the causes of failure, especially when they happen during train operations, without introducing any disruption to the service to schedule a specific check with a visit to the site. This work investigates the design of a stereo vision system that can be mounted on diagnostic trains so that a virtual visit to the site can be done when needed, by providing a 3d reconstruction of the surrounding of a train path. To achieve this, in the proposed system two color cameras can be mounted on the head or tail locomotive in a stereo configuration. They are triggered by an axle encoder mounted on the train at a fixed distance of 2 mt. This way the acquired point clouds can be registered together to achieve a full 3d reconstruction of the train path so that an offline, remote inspection of parts of the rails and catenaries can support in detecting, and possibly prevent, future anomalies. Moreover, since the reconstruction extends beyond train paths for a few meters, the 3d reconstruction of the railway can be exploited in different ways too, for example by preventing that foreign objects invade and jeopardize the train loading gauge.