3-D models from cheap video cameras

September 4 2018

Credit: Linköping Universitet

Hannes Ovrén shows in his doctoral thesis in computer vision at Linköping University how 3-D models can be created from video films recorded with simple body- or robot-mounted cameras. The research opens new possibilities for both robots and humans, not least for the police and rescue services.

Research in computer vision has a major significance for the future of artificial intelligence: autonomous systems rely on the ability of robots and other systems to orient themselves and discover objects and people.

Hannes Ovrén's contribution shows how to create a 3-D model of the surroundings, based on video films taken with an inexpensive body-mounted camera. The model reproduces scale accurately, allowing measurements to be made.

"Currently, seeing robots move rather carefully, in order to keep track of where they are. In some cases, they may even have to stop in order to determine their location. This technology allows robots to move more freely and construct a model of the surroundings while moving," says Per-Erik Forssén, docent at the Computer Vision Laboratory, and Hannes Ovrén's principal supervisor.

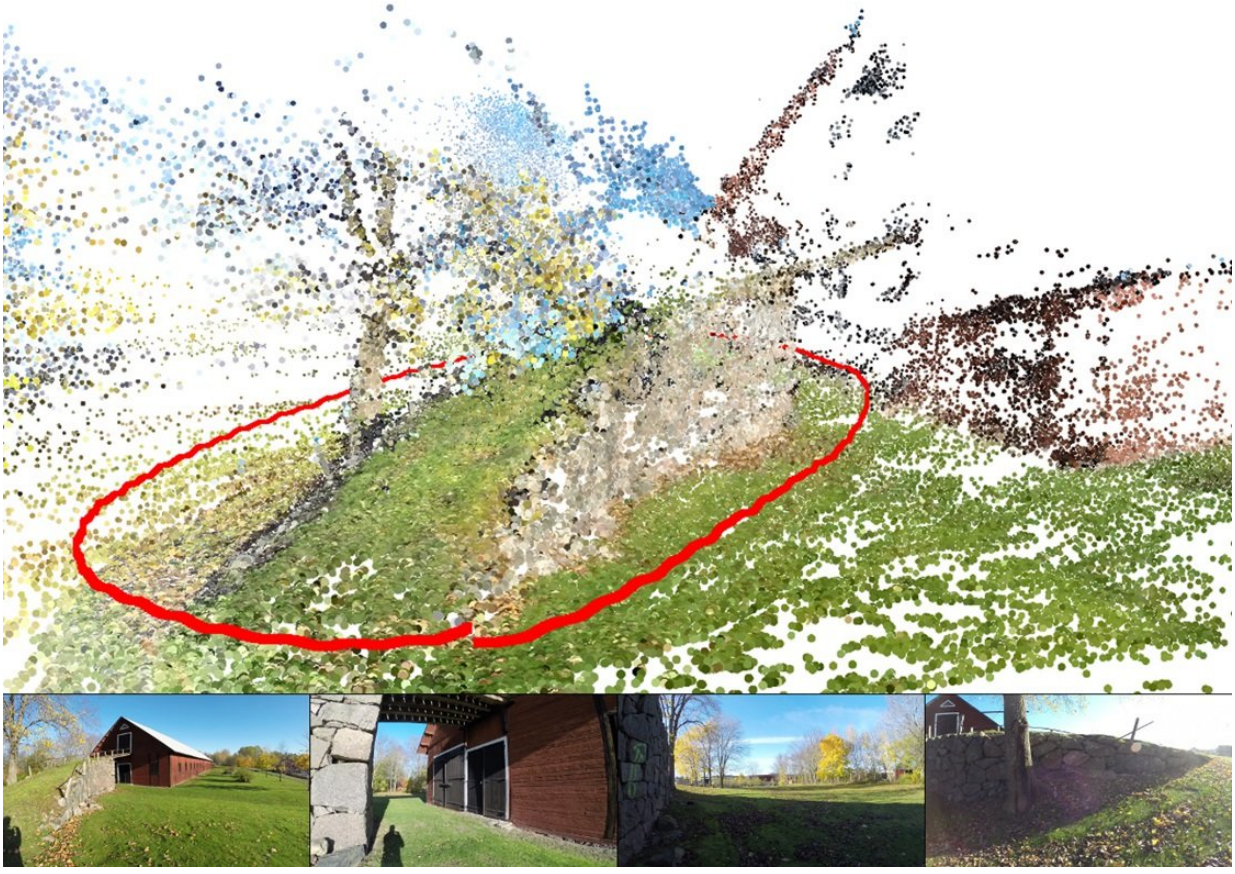
Other fields of use can be found in, for example, police work or rescue work, where personnel with a body-mounted camera can recreate a crime scene or an accident location in three dimensions, with people and objects at the exact location they had at the instant the photograph was taken.

The problem with creating 3-D models from simple video cameras has until now been that the camera must be stationary, preferably mounted on a tripod. If the camera moves, straight objects may appear to be curved in the image, or appear to be at different heights. Objects wobble, and a distorted image is obtained. This is because cheap cameras have a type of shutter known as a "rolling" shutter, which builds the image up in pixels row-by-row. Smartphones have this type of camera.

"Each image frame contains motion, but it is possible to improve the image significantly by modelling how the camera has moved and compensating for the motion," says Hannes Ovrén.

To prevent the calculations from becoming too demanding, his method creates a curve, known as a "spline," that describes how the camera has moved. This curve is constructed from spline knots, where each knot controls the appearance of the curve at a certain point in time. If the knots are placed more densely, the method can deal with more complex motion, but the calculations become more demanding.

Hannes Ovrén shows in the thesis that it is possible to use significantly fewer knots when the errors that arise due to the straightening and smoothing of the curve are modelled. In order to prevent the errors from becoming too large, the method also uses an inertial measurement unit attached to the camera. This is a small and cheap sensor that tracks acceleration, angular velocity and orientation relative to the ground.



Creation of a 3-D model. Credit: Hannes Ovrén

"The measurements from the sensor are included in the calculations and we can in this way increase the distance between knots, reducing the size of the calculations," says Hannes Ovrén.

The simplification means that the motion of the camera and the spline curve are not exactly the same. It is possible, however, to determine how the difference in pathway affects the magnitude of measurement errors, and in this way increase the reliability of the 3-D model and the distances in it.

Provided by Linköping University

Citation: 3-D models from cheap video cameras (2018, September 4) retrieved 5 July 2024 from https://phys.org/news/2018-09-d-cheap-video-cameras.html