Fast building inspection from the air

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Many buildings in Germany are in need of renovation. The reasons for this are often aging building structures and environmental influences. In the future, flying inspection robots will be able to accelerate and simplify inspections, thus reducing the safety risk. Credit: Uwe Bellhäuser

Many buildings in Germany are in need of renovation. The reasons for this are often aging building structures and environmental influences. In the future, flying inspection robots will be able to accelerate and simplify inspections, thus reducing the safety risk.

Quietly humming, the flying robot hovers up outside the high-rise. The miniature aircraft equipped with eight rotors slowly whirls upwards to the 11th floor. It examines the facade for damage, such as cracks,

defective joints, or chipped and crumbling concrete. At a distance of two meters from the building, the octocopter scans the masonry. Also on board is a high-resolution, digital camera that takes detailed images of each part of the building. In addition, the material tester is equipped with sensors that adjust for wind gusts, maintaining stable attitudes and avoiding collisions with the building. As the remote-controlled robot works its way forward meter by meter, it is carefully monitored by Christian Eschmann. He is a researcher at the Fraunhofer Institute for Non-Destructive Testing IZFP in Saarbrücken, Germany, where he develops and adapts micro-aircraft for building inspections.

Buildings, industrial plants and bridges have to bear heavy loads and are exposed to wind and weather. Many buildings in Germany were built in the postwar years and now show damage due to aging. "To inspect their condition and prevent hazards to people, a lot of effort still has to be devoted to buildings that are difficult to access," says Eschmann. To date, test engineers have inspected concrete according to the required tests with nothing but the naked eye, marking any cracks manually in 2D maps: an error-prone procedure. On top of that, places that are difficult to access or view are often only accessible by helicopters, cranes, platform vehicles, industrial climbers and scaffolding.

3D model images provide information about the state of the building structure

Compared to many conventional methods, the inspection is more convenient, thanks to the assistance of an aerial robot, and can occur at shorter intervals. In addition, inspection time can be significantly shortened, usually without impeding use of the buildings. "For a 20 by 80 meter wide façade, a test engineer needs about two to three days. Our octocopter needs three to four hours for this," says the researcher. Cracks and other flaws can now be digitally photographed in high

resolution. This permits quick conclusions about the state of a building's structure. If necessary, the octocopter can also be equipped with a thermal imaging camera, to check things such as building insulation.

The image yield is high: a mere 15-minute flight can result in up to 1,200 photos. On the computer, the individual images are combined to create an overall picture, and the resulting 2D and 3D data models illustrate the visually imageable condition of the building structure. In the future, there will be software to delete any superfluous images. A complete software suite is planned for the future, including damage recognition, image processing, a database and documentation, as well as the automation of all operations – including stitching of individual images and identification of crack patterns. The octocopter already took to the air in 2011 for its first inspection. Since then, it has completed numerous test-measurement flights. So far, it has needed to be controlled manually. Eschmann and his colleagues are currently working on navigation sensors which will control the flying robot in the future. Following a predetermined pattern, these sensors will steer the octocopter along the façades – floor by floor, from one side to the other. "It's a bit like flying on rails," says the engineer. This automation process will certainly require another year of development, though, says the researcher. Use of the aerial robot poses no risk to bystanders or passers-by. The device is equipped with eight electric motors. If one should fail, it can always be safely landed.

"Our micro-airplane are no substitute for experts or a close-up inspection. However, the octocopter accelerates the test procedure and enables permanent monitoring and documentation from the beginning. Design defects and warranty claims can be identified at an early stage, so appropriate repair measures can be taken in time. This means more security for buildings and people," says Eschmann.

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