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## Software from Fraunhofer IPM supports optimized route planning for fiber-optic networks

**Deutsche Telekom AG will optimize the planning for new fiber-optic cables in the future using infrastructure data it collects itself. To achieve this, the company is investing in optical measurement technology with automated data analysis. Fraunhofer IPM has developed software for the telecommunications group that automatically recognizes physical objects in measurement data and uses these results to relay reliable planning data for civil engineering works, one of the major risks implicit in the expansion of fiber-optic networks.**

Given the billions that will be invested in the expansion of the data infrastructure in the coming years, optimized route planning guarantees an enormous potential for savings, but it requires reliable infrastructure data. The data that has been available until now, for instance official maps or aerial photographs, is in many cases obsolete, imprecise or incomplete, or has a poor spatial resolution. Before construction begins, the area in question is typically visited and documented. Survey vehicles are only used occasionally to collect additional images or 3D data. Any and all drafts, photos, measurement images and 3D point clouds have to be manually viewed and evaluated by experts. To make this process more efficient, Deutsche Telekom AG has recently shifted its focus to geo-mapping data which the company itself generates and which is then automatically interpreted and classified using cloud-based software developed at Fraunhofer IPM.

The data is collected prior to construction by the survey vehicles of a measurement service commissioned by Deutsche Telekom. Several cameras and a laser scanner record the stretches of road where work is scheduled. The 2D and 3D data provides geometric information as well as details about the ground, the street furniture or local vegetation. "The shortest route to the customer is not always the most economical. By using artificial intelligence in the planning phase we can speed up our fiber-optic roll-out. This enables us to offer our customers broadband lines faster and, above all, more efficiently," says Walter Goldenits, head of Technology at Telekom Deutschland. It is even often more economical to lay a few extra feet of cable.

### Automated data analysis based on deep learning

Measurement data should be as detailed as possible for optimal route planning. "The enormous amounts of data we work with are both a blessing and a curse," says Prof. Dr. Alexander Reiterer, manager of the project at Fraunhofer IPM. "We need as much detail as possible, but the whole process is only efficient if people don't need to painstakingly scour the data for whatever information they're looking for. To be able to

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plan efficiently, the evaluation of these vast quantities of data has to be automated." Fraunhofer IPM is developing software for just that. It will automatically recognize, localize and classify the relevant items in the measurement data. For this fully automatic interpretation to work, the data must conform to a specified quality and structure. A complex process integrating the use of deep learning is in charge of the data analysis. The algorithm is "trained" to recognize typical street obstacles on the basis of comprehensive data and can then add semantic information to the measurement data. For this purpose, Fraunhofer IPM has developed a training data record with more than 30 types of obstacles including, for instance, vehicles, curbs, manhole covers, signs, trees and hedges. Additionally, the training data covers different seasons, atmospheric conditions and lighting situations. After the measurement data has been analyzed, the planning department of Deutsche Telekom AG will receive a digital plan of the area for automated route planning. In addition to categorized surfaces, this plan contains current information on the position of obstacles such as trees, guardrails and walls. Information on the area's surface topography is also provided, for example where an easy-to-dig median strip or loose ground is located, or where there is a layer of asphalt or concrete.

### 3D information increases reliability

To increase the reliability of the analysis, a comprehensive set of heuristics was applied to the data. This includes, for example, the analysis of incomplete, overlapping and inconsistent data. Since 3D information gathered by laser scanners is evaluated in addition to the 2D camera images, such heuristics can be used in the 3D realm. This way, neighboring obstacles are reliably separated and overlapping obstacles are recognized, for example trees or vehicles located close together or partially hidden by one another. Another advantage is that the 360° laser scanner located atop the survey vehicles does not just gather data for a single section of the area in question (e.g. the ground or the surface of the street), but also that of areas higher up. This is important for planning tasks related to WTTH (wireless-to-the-home), where the local loop is implemented wirelessly. Planning data for the installation of access points, for example on street lamps, must also be as detailed as possible. In its final stage of completion, the software will be able to recognize singular obstacles with a reliability of over 80 percent.

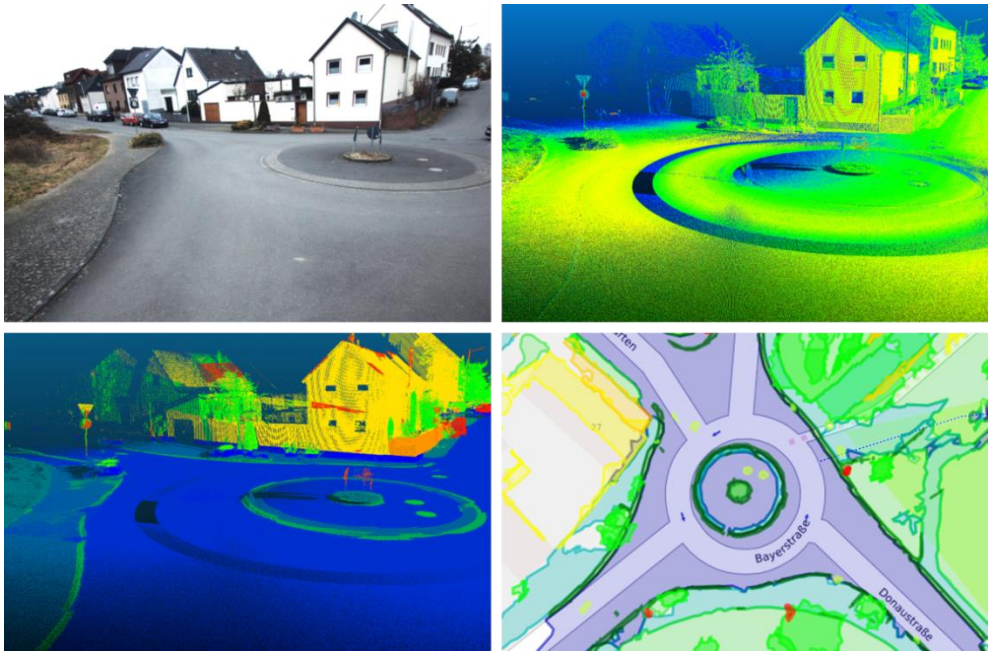
**Further information:**

*Expansion of broadband*
Deutsche Telekom invests about five billion euros each year. It operates the largest fiber-optic communication network in Europe, employing over 460,000 kilometers of glass fiber, and is focusing all its efforts on the expansion of broadband, having installed about 40,000 kilometers in 2017 alone. This figure will rise to 60,000 kilometers for 2018, increasing Deutsche Telekom's entire fiber-optic network to more than 500,000 kilometers.

*Fraunhofer IPM*
The Fraunhofer Institute for Physical Measurement Techniques IPM develops customized measurement techniques and systems for the industrial sector. Optical measurement systems for the mobile 3D mapping of the geometry and location of objects make up one of its major focal points. To aid in this, the institute designs and builds laser scanners, lighting units and camera systems to be used atop trains and motor vehicles. The efficient evaluation of measurement data is becoming increasingly important. Against this backdrop, the institute's projects are increasingly concentrated on the development of data interpreting software. In this area, Fraunhofer IPM is developing smart algorithms based on the concept of deep learning.

**MoLaS – Mobile Laser Scanning Technology Workshop**

On November 14 and 15, 2018, Fraunhofer IPM is hosting the third international Mobile Laser Scanning Technology Workshop (MoLaS) in Freiburg, presenting key technology drivers and future applications in the field of 3D mapping with mobile laser scanners. The four sessions on sensors, calibration, data interpretation and visualization, and applications respectively will cover the entire spectrum of laser scanning technology.




**2D camera data (upper left) and 3D laser scanner data (upper right) depict the infrastructure quickly and efficiently. The 3D data is automatically analyzed using smart algorithms (lower left). Each color in the point cloud represents a singular class of objects. This data is then transferred to a digital planning map (lower right) for automated route planning. In addition to the categorized surfaces, this plan contains current information on the position of the objects.© Fraunhofer IPM**



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