UAV-based gas pipeline leak detection

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Presentation preference: Poster

Suggested topic: New Generation Sensors and Applications $\rightarrow$ Airborne Sensing, UAV

Inspection of onshore gas pipelines for gas leaks is an expensive undertaking due to the costs for personnel and equipment. This is particularly true in remote areas, where helicopters are used. One way to reduce costs is the deployment of small-sized unmanned aerial vehicles (UAVs), which can be operated with minimal deployment infrastructure. However, payload capacities for sensors are limited on these platforms and sophisticated processing is required, in case the system is operated autonomously.

This paper describes a system that carries out remote sensing missions using a combination of lasers and an electro-optical sensor to detect gas leaks in unburied onshore pipelines. A camera in the optical wavelength range is utilised to track the pipeline automatically with the actual algorithm running onboard. The extracted position information together with the attitude of the UAV is used to orientate a pair of lasers mounted on a gimbal to sense the pipeline and its immediate surroundings. The corresponding readings can be directly related to the concentration level of the gas, i.e. methane. However, due to the functional principles of lasers, only point-sampling can be achieved. In order to cover the entire pipeline, a whisk-broom scan pattern similar to the original Landsat design is generated by controlling the gimbal accordingly. As an option the design allows for integration of a mid-wave infrared (MWIR) camera for detailed post-mission analysis of detected gas leaks.

The proposed system allows the pilot of the UAV to focus on the actual flight control and can easily be integrated in autonomous operating platforms as well.