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The Application Research of Oil Pipeline Patrol by UAV in PCOC

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Abstract. The petroleum pipeline distribution range of PCOC (Petrochina Changqing Oilfield Company) is wide, with a complex terrain and a difficult task for pipeline patrol and protect, at present mainly adopts manual inspection method, single inspection way cause inspection workload is huge, inspection efficiency is low, also there is personnel injury risk. UAV as a new type of inspection equipment, can be to carry out the engineering survey, the pipeline monitoring and routine maintenance inspection work, greatly improve work efficiency, reduce the risk of injury. UAV application in electric power patrol has matured, and accumulate more achievements and experience, in the oil pipeline patrol applications has not yet mature. To prove the feasibility of UAV oil pipeline patrol, PCOC found a test for pipeline patrol and protect which lasted three months in year 2016, the efficiency and quality for oil pipeline patrol and protect, safety performance, economic benefits have achieved good effect, lay the foundation for the large-scale application.

Introduction

The working area for PCOC is in China's second largest basin- Ordos basin[1], across five province as the Shaanxi province, Gansu province, Ningxia hui autonomous region, Inner Mongolia, Shanxi province, with the huge pipeline distribution range and the complex terrain and changeful buried depth. The inspections of pipeline damage and pipeline maintenance task is very difficult.

Changqing oilfield mainly adopts artificial checking mode at present[2,3], there are some work difficulty, feeder polling period for once a month, main and single well pipeline inspection cycle for every quarter, inspection staff workload is huge, enormous human cost. The distance between the single well in the changqing oil field areas is very long, and the environment for esert and animal husbandry is very complex[4,5,6], and the complex terrain of inspection line, which cause the way of manual inspection is inefficient by walking. Labor patrol also has the risk as personnel injury [7].

The UAV inspection as a new mode of patrol, aviation, communication, geographical information, image recognition, information processing technology in a body, low-altitude photogrammetry is very cheap and easy to operate relative to manual checking and manned machine photogrammetry [8]. UAV inspection has big advantage, high efficiency, less affected by the factors such as temperature and terrain, and the high quality and safety performance for patrol[9].

The Application of UAV Inspection

Some domestic oil and gas industry has to carry out the study of UAV inspection application. West-east gas carried out the UAV inspection experiment in the Shanghai natural gas pipeline in year 2012, Hohhot carried out the UAV inspection experiment in the crude oil pipeline in year 2013, Puguang gas field carried out a block in outsourcing way for UAV inspection experiment in October 2015, Shengli oil field carried out the 100-square-kilometer oil inspection test in outsourcing way for UAV inspection experiment in year 2016.

In the same test under the guidance of the successful experience of UAV patrol[10,11], the demand of Changqing oilfield for UAV to participate in the patrol is urgently.

(1) In oder to improve the level of construction inspection, there is an urgent need to introduce the new and high technology and testing tools for oil field.

(2) Because of the UAV technology develops very fast in the domestic, with constant expansion of UAV applications, across industries, across technology integration has become a reality.

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(3) UAV regulatory policy is gradually perfect.

Changqing oilfield organized several UAV manufacturers to carry out UAV oil pipeline inspection in year 2016, hope that through uav patrol line, can discover the pipeline leakage, reduce the risk of security environmental protection, enhances the working efficiency of the patrol, effectively reduce the staff to patrol work, raising the level of safety control in oil and gas fields.

The experimental study of UAV patrol has a total of 12 UAV manufacturers to participate in the test, a number of leaders and experts to participate in the project, get a lot of real data.

The UAV inspection application of DCOC study mainly in six aspects such as UAV basic hardware applicability, environmental indicators, horizon and over-the-horizon patrol[12,13], patrol imaging performance, patrol pattern, the uav patrol management mode, these manufacturers carry out a large number of trials about technical requirements above, obtained a large number of detailed test data and information.

The inspection in height is 120 m, 70 m and 65 m. With high precision, high effective pixels, SONY 5100 camera, under three kinds of highly fixed-wing UAV can effectively obtain pipeline, station, compressed garbage exposed, fences, roads and other targets. Fig .1 is sample of naked pipeline photograph, shortage of road photograph, dirty water photograph and animal husbandry area fence photograph. At the same time as having the pictures, the inspection also get the each photo the GPS coordinates corresponding to the UAV at the point time of the shooting and UAV's flying, these data can provide data support for late image mosaicing.

In the environment of daytime, thermal imaging tests are carried out respectively through automatic flight operation. During the daytime, the ground temperature is higher, and the average temperature of ground is about 33 degrees, pipeline can clearly distinguish the leak out of the ground part, but buried pipeline is difficult to identify, also is unable to distinguish whether the pipeline

Figure 1. Finite Samples photograph by 65 m

(a. Sample of naked pipeline photograph by 65 m;
b. Sample of shortage of road photograph by 65 m;
c. Sample of dirty water photograph by 65 m;
d. Sample of animal husbandry area fence photograph by 65 m.)

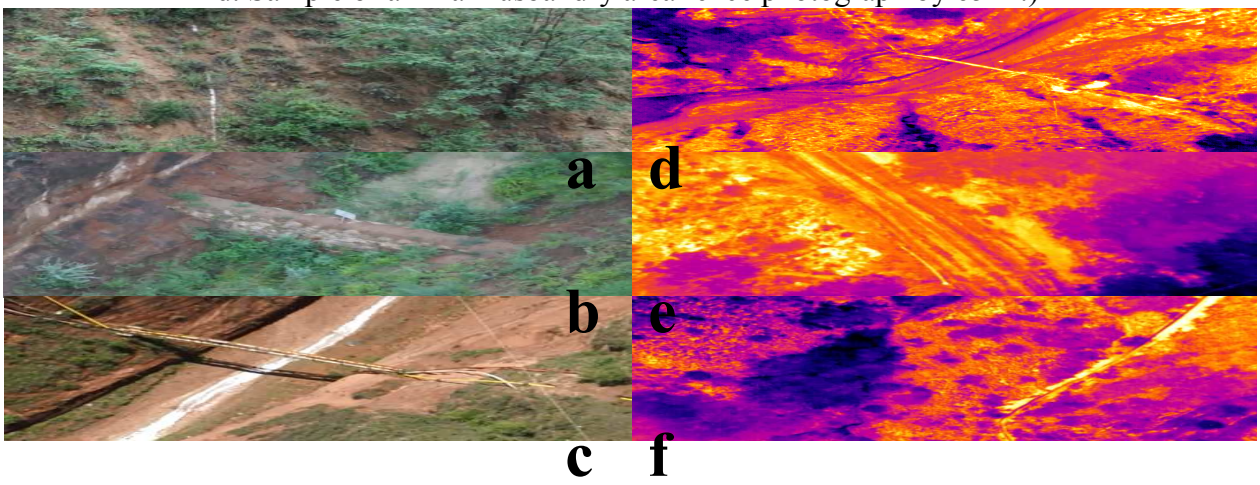

Figure 2. Finite Pipeline image

(a. Pipeline image along the mountain; b. Used oil dam image in valley;
c. Bridge pipeline image in valley; d. Pipeline bridge thermal imaging;
e. Pipeline thermal imaging along the mountain road;
f. Pipeline thermal imaging along the mountain.)

leakage, which is shown in Fig .2. The pipeline image along the mountain, used oil dam image in valley, bridge pipeline image in valley, pipeline bridge thermal imaging, pipeline thermal imaging along the mountain road, and pipeline thermal imaging along the mountain are clearly visible.

Conclusion

The UAV pipeline patrol test in changqing oilfield, is the first time the application domain of domestic system experiment, verified the patrol drones in the oilfield application feasibility and comprehensive treatment.

UAV pipeline patrol and protect less affected by factors such as temperature, terrain and has high quality and safety performance for patrol; can to a certain extent, reduce artificial patrol the intensity of labor, improve supervision efficiency, reduce the patrol maintenance cost; can get all kinds first-hand information of damage to oil facilities and rapid accurate oil theft behavior, to provide technical support for the efficient precision when oilfield comprehensive treatment.

The application prospect of UAV pipeline patrol and protect is widespread, could mainly divided into five aspects: the construction of productivity application, application of maintenance, production service application, emergency services applications, emergency rescue and application.

But the environment and requirements of oil field is different from the actual production, universality and stability of the UAV patrol technology needs to be validated by further testing and fumble, at the same time, some of the parameters and oil field patrol management has a certain gap, need further improvement and optimization.

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