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The Research of Oil Pipeline Patrol by UAV in the First Sub-Factory of PCOC

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Abstract. The main body of PCOC (Petrochina Changqing Oilfield Company) is in the Ordos Basin, exploration with a total area of about 37 square kilometers, and whose exploration area is highly fragmented. The situation of the pipeline rupture emerge in endlessly as the result of natural conditions and human factors each year. The first sub-factory of PCOC is located in the Yishan Slope of the Ordos Basin in Yan'an, all of the region is hilly gully region, most of the oil pipeline is laying along the topography, which is difficult for labor patrol, UAV patrol is still in stage of testing. The STX-100 four rotor industrial-grade UAV has good performance, suitable for complex area of oil pipeline patrol work, can effectively relieve the staff.

Introduction

Changqing oil field is China's largest oil and gas fields. Main exploration area in Shaanxi province, Gansu province, Ningxia hui autonomous region, Inner Mongolia, Shanxi and other five provinces of 15 cities and 61 counties (banners), the main body is in the ordos basin, which with a total area of about 37 square kilometers, and highly fragmented[1,2,3].

Each year as a result of natural conditions and human factors, leading to the situation of the pipeline rupture emerge in endlessly[4,5]. After a large number of oil spill, the plants will be dying and the land will not be plowing because of the oil infiltration in the topsoil, and polluted river or ocean killing oxygen to aquatic animals, and to polluting the air because of evaporation by sunlight exposure. People and animals inhalation or skin contact with toxic substances in huge quantities of crude oil (including benzene, toluene and xylene, etc.) [6], can cause acute and chronic poisoning, and even deadly. So oilfield company every year need to spend a lot of manpower and material resources for oil pipeline patrol work.

The first sub-factory of PCOC is located in the Yishan Slope of the Ordos Basin in Yan'an, all of the region is hilly gully region[7,8,9], most of the oil pipeline is laying along the topography, which is difficult for labor patrol. So you would like to explore drones in the pipeline patrolling, alleviate patrol staff workload. This experiment adopts the STX-100 four rotor industrial-grade UAV, the machine has features such as simple operation and good performance, through a series of oil pipeline patrol test, it can get a clear image of pipeline, and can satisfy the complex terrain and complex weather conditions of oil pipeline patrol work.

The STX-100 Four Rotor Industrial-Grade UAV

The STX-100 four rotor industrial-grade UAV has a main fuselage with the size of 1060*1060mm, and with the weight of 4kg (carry a battery with 20000mAh), the fuselage carrying a GOPro high definition SONY digital camera, this UAV battery life is about 40~60 minutes, wind loading for level 6, resistance to rain to moderate rain grade, the biggest work scope could reach 12 km, cruise way for

autonomous cruise, remote control[10,11]. Main configuration and parameters are shown in Table 1, Table 2.

Table 1 Main configuration of the STX-100 four rotor industrial-grade UAV

NO.	Equipment and personnel	Contains
1	STX-100 four rotor industrial-grade UAV	One piece
2	Portable ground control station	One set
3	Staff	One operater and One support staff

Table 2 Main parameters of the STX-100 four rotor industrial-grade UAV

Name	Battery life	Wind loading	Radius control	carrying	cruise way
indicators	40~60 minutes	level 6	10 km	hd digital camera	autonomous, remote control

Patrol Experimental Study

According to the requirements of PCOC about UAV patrol, this experiment mainly aimed at the flight test and record for related data with visual range and beyond visual range at day also and thermal imaging at night; using a combination of visual range and beyond visual range flight, through the cruise way by autonomous and remote control, test the applicability of the UAV and handling, and record patrol data through the load equipment.

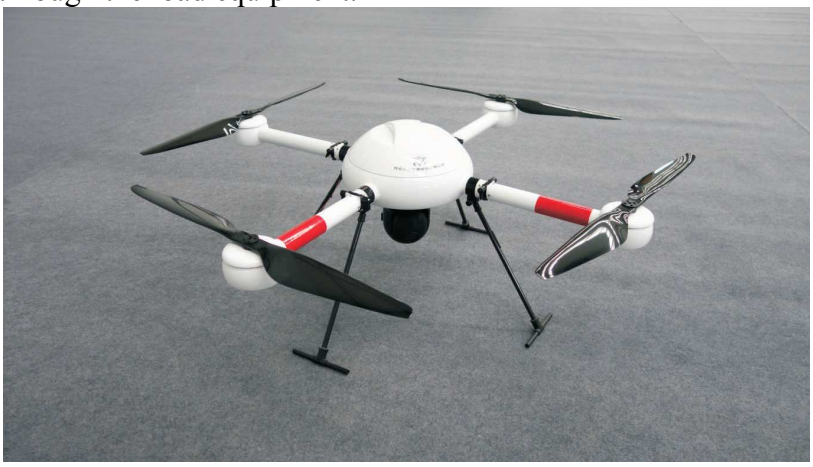

Figure 1. Finite The STX-100 four rotor industrial-grade UAV

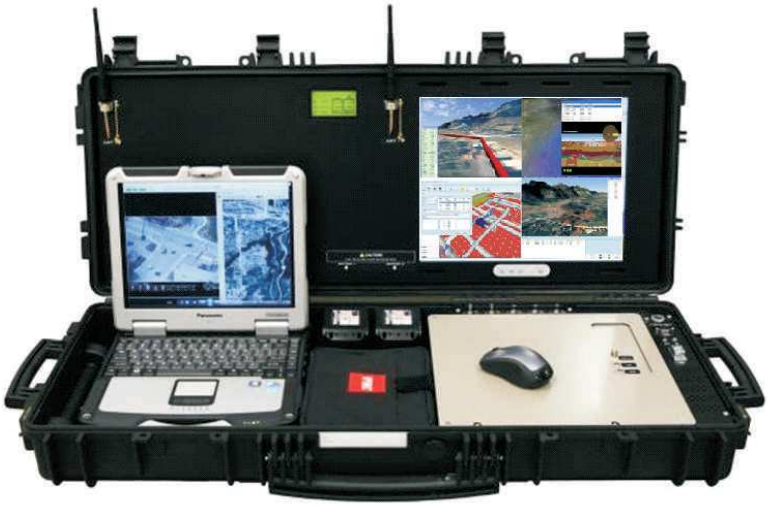

Figure 2. Finite The STGCS-100M ground station

The complex geographical environment of the first sub-factory of PCOC, requst the performance indicators and the equipment that carrying for UAV could meeting the requirements. Put forward very high requirements on reliability, maintainability, affordable and environmental adaptability about UAV. Through on-the-spot inspections flight testing of UAV comprehensive operation ability is the most direct means.

In the process of the actual test, different location shooting back high-definition video and photo information to be able to see the actual pipeline, because of the GOPro high definition SONY digital camera, particular case is shown in Fig .3, Fig .4.

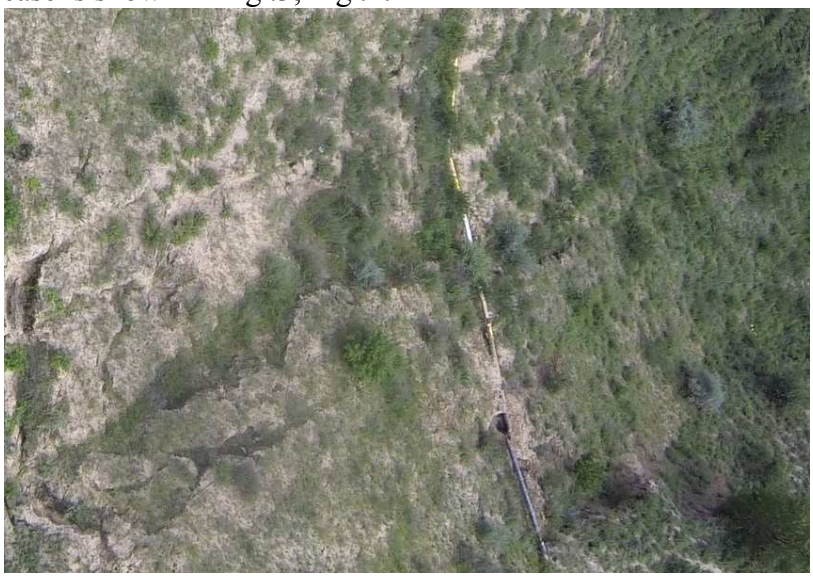

Figure 3. Finite Pipeline image along the mountain

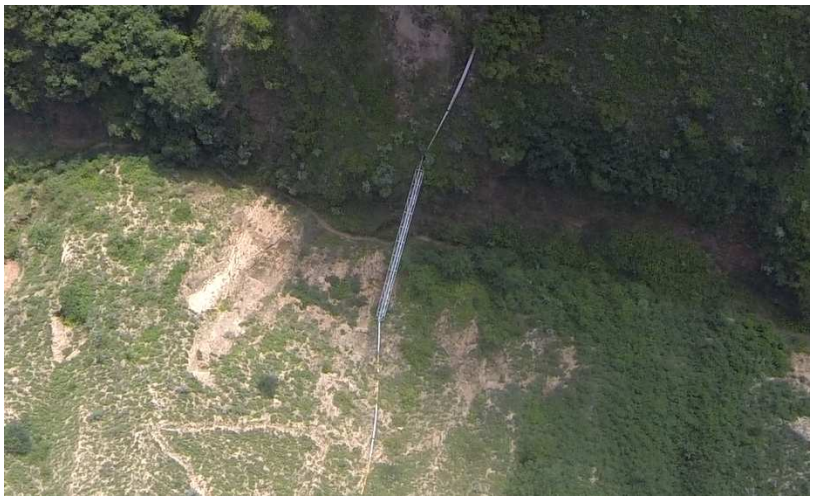

Figure 4. Finite Bridge pipeline images in valley

Table 3 The situation of pipeline patrol

NO.	Date	Patrol target	Patrol process	Patrol reslt
1	2016.08.02	Pipeline bridge	When after liftoff that about 1.5km to the pipeline bridge, the UAV shaking because of the gust, in order to guarantee safe, UAV landing.	Crosswind was so strong, as the flight is not stable, the patrol was terminated.
2	2016.08.03	Oil well, Pipeline bridge	Liftoff by somewhere that about 0.4km to the pipeline bridge, UAV reach above the pipeline bridge by the height of 20 meters, then continue on pipeline patrolling about 1.5 km, and return at the last.	Pipeline bridges and lines are clearly visible, and everything is ok.
3	2016.08.04	Oil well	Liftoff in north apricot area, flying to the two wells by distance of 1.5km.	UAV flights stability quickly and real-time image visible.
4	2016.08.05	Pipeline bridge	Liftoff by somewhere that about 1.8km to the pipeline bridge, UAV reach above the pipeline bridge by the height of 40 meters.	Image is clearly visible, pipeline bridges and lines are all right.

Conclusion

This experiment adopts the STX-100 four rotor industrial-grade UAV, whose biggest battery life is 60 minutes when cruising, and whose control station contains remote-control unit and ground control station, the operation is simple. The clarity of the image is very well, is able to see the actual pipeline, also can meet the demand of oil pipeline patrol in complex area by cruise battery life, flighting distance and automatic flight.

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