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Unmanned Aerial Vehicles and Dynamic Pipeline Pressure Profiles: Tools for Oil-Spill Detection and Localization

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Abstract

Pipeline Oil spill is a major challenge with the Oil and Gas production process as it impacts negatively on the environment, the reputation and the finances of the operator. Real time pressure data from an Oil and Gas Pipeline can be used with specially developed algorithms to create dynamic pressure profiles of the pipeline. This profile shows the pressure map of the entire pipeline and it can be used to detect the onset of a leak. Production management systems can be configured in the exception based reporting mode to generate alerts whenever there is a variation in the pressure at any point on the pipeline. The location of pipeline right of way in remote locations increases the monitoring costs and response time in the event of a leak. This paper presents the deployment of Unmanned Aerial Vehicles (UAVs) as the first line of response to alerts generated by the production management systems and the dynamic pressure profiles to provide real time video feedback of the leak points. This will enable a rapid detection and localization of the leak points enabling the speedy deployment of the response teams. The combination of the dynamic pipeline pressure profile and the UAV will provide a rapid monitoring system for the entire pipeline network and facilitate rapid intervention in the event of a leak or any activity on the pipeline right of way providing real time video feedback of the area under investigation and eliminating response to spurious signals and false alarms.

Introduction

The increasing demand for energy and the dominant position occupied by crude oil in the global energy supply mix shows that the reliance on crude oil as a source of energy is far from over [1][2][3]. The oil and gas production process involves the exploration and production of oil and gas from reservoirs underground. The oil produced from these reservoirs is transported using pipes from the

different oil wells to the export processing terminals or the processing facilities. Pipelines have proven to be the cheapest and most effective means of transporting crude oil and its associated derivatives from one point to another especially over long distances. They consist of several sections of pipes joined together and buried underground or placed above ground. The pipeline network is a combination of different sections of pipelines with booster stations or pumps inserted at different points to make up for pressure lost during the fluid transmission. Pipelines traverse several communities covering hundreds and thousands of kilometers including farmlands, communities, rivers etc. A typical pipe network with pressure sensors installed at the end of each pipe section is shown in figure 1. The total frictional loss of the pipeline network is the sum of the frictional losses of each section of the pipe.