Literature survey

[FOR GAS LEAKAGE MONITORING AND ALERTING SYSTEM]

Gas leakage is a major problem with industrial sector, residential premises and gas power vehicles like CNG (compressed natural gas) buses, cars. One of the preventive methods to stop accident associated with the gas leakage is to install gas leakage detection kit at vulnerable places. In particular gas sensor has been used which has high sensitivity for propane (C3H8) and butane (C4H10). Gas leakage system consists of GSM (Global System for mobile communications) module, which warns by sending SMS. However, the former gas leakage system cannot react in time.

The worldwide natural gas transport and distribution network is a complex and continuously expanding one. According to the study presented in (TRB, 2004), pipelines, as a means of transport, are the safest but this does not mean they are risk-free. Therefore, assuring the reliability of the gas pipeline infrastructure has become a critical need for the energy sector.

The main threat considered, when looking for means of providing the reliability of the pipeline network, is the occurrence of leaks. Regardless of their size, pipeline leaks are a major concern due to the considerable effects that they might have. These effects extend beyond the costs involved by downtime and repair expenses, and can include human injuries as well as environmental disasters. The main causes of gas pipeline accidents are (EGIG, 2008): external interference, corrosion, construction defects, material failure and

ground movement. To counteract the disastrous effects of gas leaks, considerable effort has been invested, during the last decades, in designing gas leak detection techniques. However, revealing the presence of a gas leak is not sufficient in order to define an efficient counteracting measure. Before deciding on a set of corrective actions, other information has to be known such as: the location of the leak, its size, etc. These subjects were also in the focus of research done in the field of pipeline reliability assurance.

The occurrence of gas leak-related incidents was studied by several organizations which published statistics on the reported incidents. One of these studies, made on the sub-sea pipeline systems (SLR, 2009), states that, between 1996 and 2006, a number of 80 pipeline rupture incidents were reported in the Gulf of Mexico and Pacific areas. Based on data gathered in this report, the calculated probability of a catastrophic incident, for the specified area, is 0.43 incidents per year.

Another survey (Konersmann et al., 2009), which focuses on the risks of pipeline transportation, covers incidents that occurred in Europe and on the American continent presenting the main causes of pipeline failure. According to this report, in the province of Alberta/Canada alone, there have been 1326 reported gas leaks in the 2001-2005 period. A different report shows that large pipelines (i.e., with a length of 800 miles or more) can expect at least one reportable leak-related incident per year (ADEC, 1999). This evidence indicates that the risk of incidents caused by gas leaks is substantial despite the great variety of leak detection methods available and serves as motivation of our work.

The main purpose of this paper is to identify the state-of-the-art in gas leak detection techniques and to present localizing capabilities, as well as other important features, for each of the studied methods. We achieve this by performing an extensive survey of the literature in the field, covering results from academia as well as industry reports.

A number of reviews on the subject of gas leak detection techniques were done in the past either as part of research papers/technical reports on a certain leak detection method and other gas related subjects (Zhang, 1997; Matos et al., 2006; Folga, 2007; Liu et al., 2008; Batzias et al., 2011) or as a result of research dedicated to this specific purpose (Jolly et al., 1992; Stafford and Williams, 1996; ADEC, 1999; Wang et al., 2001; Scott and Barrufet, 2003; Sivathanu, 2003; Geiger et al., 2003; Loth et al., 2003; USDT, 2007; Turkowski et al., 2007; El-Shiekh, 2010). Although they provide a good overview on existent leak detection techniques, these surveys are either succinct, omitting several leak detection methods or, in some cases, not of a recent date. In order to decide which leak detection technique is more suitable for a given setting, a comparative performance analysis is necessary. For this we compare the studied methods by a set of common features using performance reports from literature.

As a conclusion, and apparently future trend, a hybrid approach combining different detection methods to achieve the required system performance would be the best choice.