The consequences of corrosion can be both expensive and dangerous. In the USA alone, corrosion has been estimated to cost the petroleum industry around $8 billion a year. Corrosion damages to pressurized components, such as pipes and boilers, can lead to sudden failures, fatalities and environmental catastrophes. Ultrasonic wall thickness measurement is one of the most used field-deployable techniques for assessing and surveying the effects of corrosion. However, the manual setup and operation of ultrasonic testing equipment often results in poor wall thickness measurement repeatability (~ 0.1 - 0.5 mm). These errors are mainly due to surface preparation, and positioning and coupling errors that are associated with the manual setup of the measurement.

It has been demonstrated that the repeatability of ultrasonic inspection can be improved significantly by the use of permanently installed transducers [1]. Measurement precision in the micro-meter range has been achieved for wall thickness monitoring [2, 3]. While it is very difficult to avoid corrosion altogether, industry is interested in detecting corrosion rates that are larger than ~ 0.1 mm/year so that corrosion mitigation strategies for maximizing plant life can be effectively put in place. With manual measurements the corrosion rates of interest can only be detected over time frames that span years. Ultrasonic monitoring with a repeatability of the order of micro-meters means that corrosion rates of industrial interest (i.e. 0.1 mm/year or 270 nm/day) can be detected over a time frame of several days or even weeks.

In this paper, an optimized wall thickness monitoring setup with a wall thickness measurement repeatability of 40 nm will be introduced. This enables the detection of the abovementioned corrosion rates over the periods of hours rather than days or weeks. The ultrasonic measurements presented in this paper have been verified by the results of an optical technique and, where possible, by analytic models. The effects of signal-to-noise ratio and temperature variation will be discussed in detail.

References: