Collaboration between University of Kent and KROHNE to Incubate Research Ideas into a Commercial Prototype

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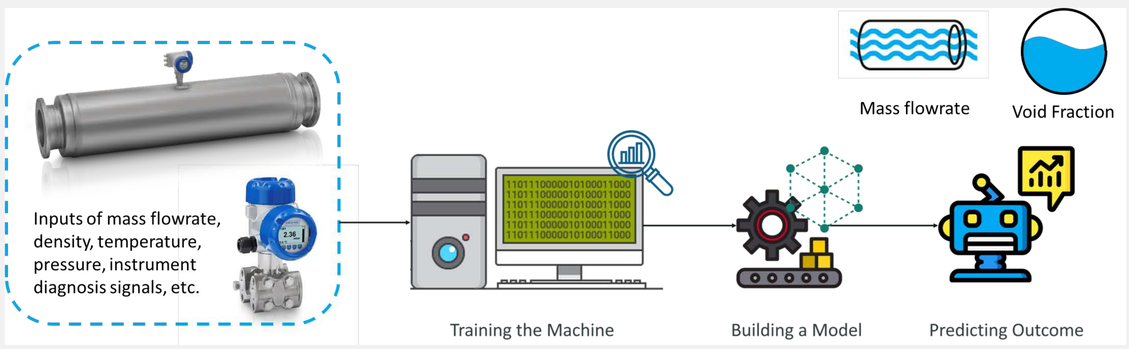
Introduction

A 2-year KTP project that completed on 31st March 2020 has witnessed the transformation of a research idea into a prototype with commercial potentials. The idea of using soft-computing models to enhance Coriolis flowmeter's performance attracts both University of Kent and KROHNE Ltd into this collaborative KTP project. With the improvements made on Coriolis flowmeter to measure gas-liquid two-phase flow, the core product of KROHNE Ltd can outperform its competitors through the capability to deal with inevitable short burst of gas entrainment during single-phase flow measurement and even challenge the radioactive or nuclear magnetic resonance based two-phase flowmeters which are prohibitively expensive.

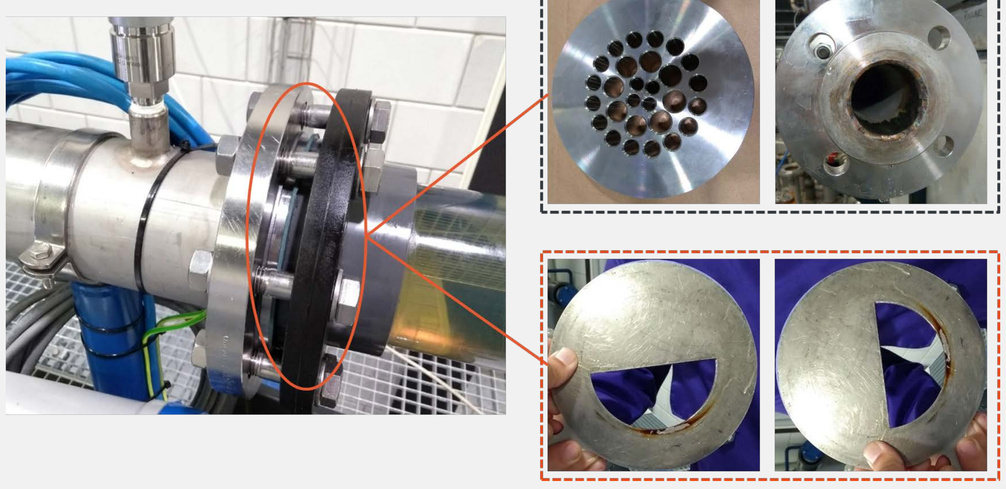
Methodology

Coriolis flowmeters are ideal for mass flow metering of single-phase flow. However, their performance will deteriorate significantly if they are used to measure gas-liquid two-phase flow. By implementing a soft-computing algorithm in the existing converter of the Coriolis flowmeter, the relative mass flowrate error under gas-liquid two-phase can be reduced from 80% to mostly within 10% under different test conditions. A flowchart of the algorithm is shown below.



Experimentation

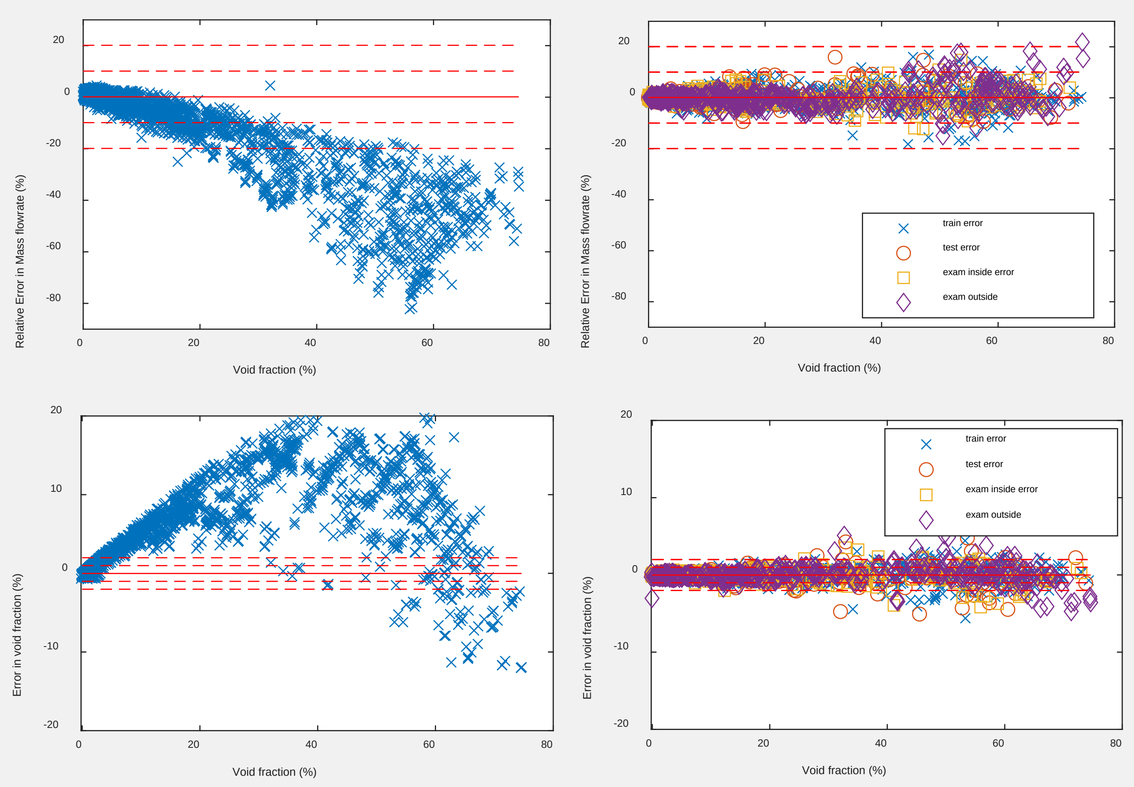
An industrial scale KROHNE OPTIMASS 2400 Series Coriolis flowmeter was used in the experimental studies. Extensive experimental work on a purpose-built 4-inch bore air-oil flow rig to record the behaviours of the Coriolis flowmeter has been conducted.



A wide range of liquid flowrate, viscosity and void fraction have been tested. A multi-hole flow conditioner and a half-moon flow conditioner with openings from the bottom and the side were used to simulate the potential disturbances upstream of the Coriolis flowmeter together with the no conditioner test conditions.

Test of this scale can only be realized with the help of the business. KROHNE Ltd, as one of the leading Coriolis flowmeter manufacturers, has provided in-depth support on their product of Coriolis flowmeters, test facilities to run large scale trials as well as finance support for conducting tests in expensive commercial laboratories. In the meantime, researchers from two schools of University of Kent have provided expertise and experience in soft-computing techniques as well as multiphase flow metering.

Results



Error without (left) and with (right) developed algorithm

Conclusion

The mass flowrate measurement with the soft-computing algorithm is able to achieve mostly within ±10% relative errors under a variety of test conditions, including those outside training conditions. In addition, the algorithm is also capable of estimating the void fraction to an accuracy of mostly within ±2%. This achievement is only possible through the collaboration between business and academia by putting resources and expertise of industry and research together.

Acknowledgement

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