

Adaptive Delay Lines for High-Speed Range Measurement

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High-speed, long-range frequency scanning interferometry (FSI) requires expensive data acquisition hardware (DAQ). An adaptive delay line (ADL), with N exponential delays, can increase the maximum measured range or the range sample rate by a factor of 2^N , while relaxing coherence length requirements by the same factor.

1. Cost of DAQ Hardware for Ranging

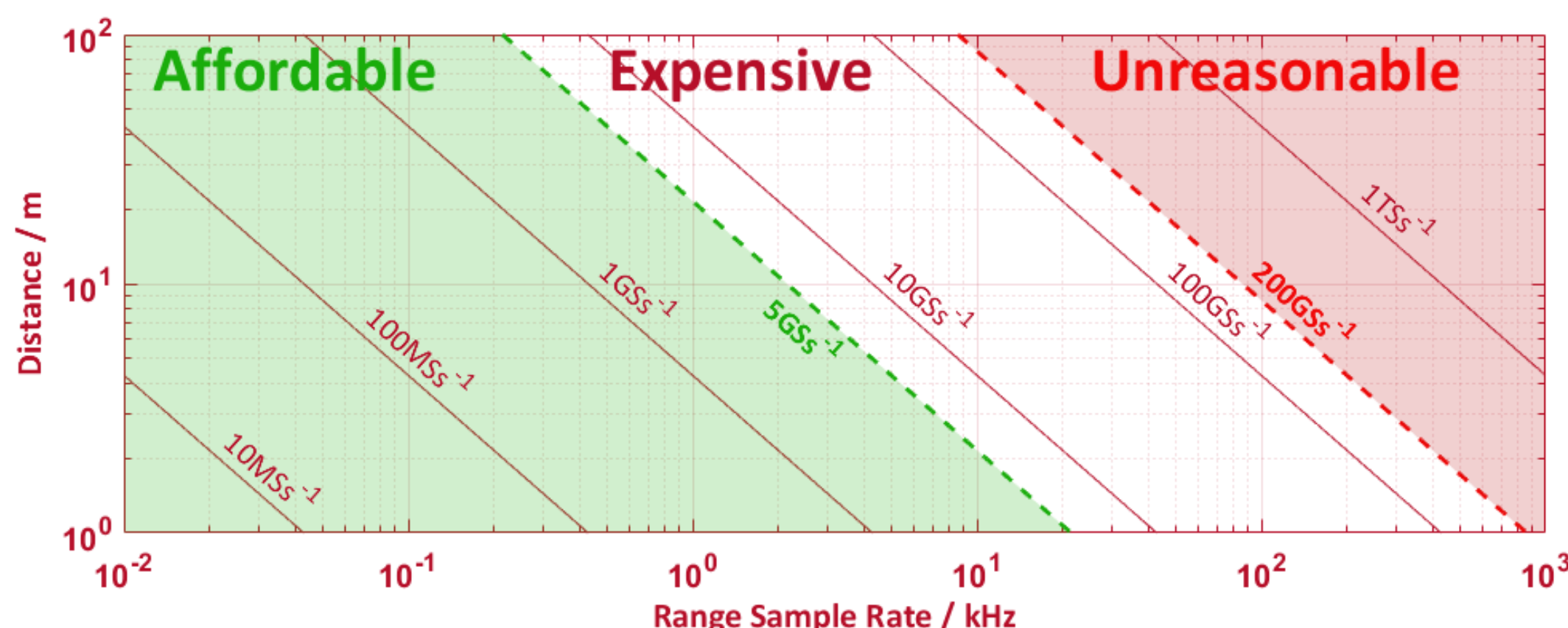


Fig 1 – Per channel DAQ rates required for different target ranges and range sampling rates

2. ADLs Reduce Modulation Frequency

$$f_M = \Lambda \alpha f_s \frac{\Delta \lambda}{\lambda_c^2}$$

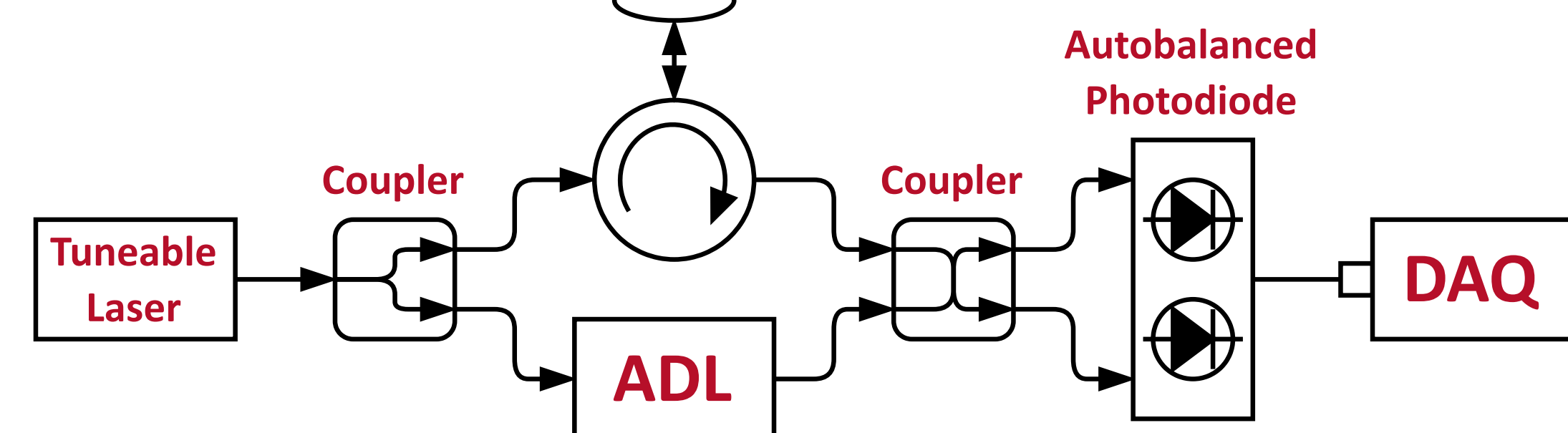


Fig 2 – Schematic of FSI system with ADL

3. ADL Configurations

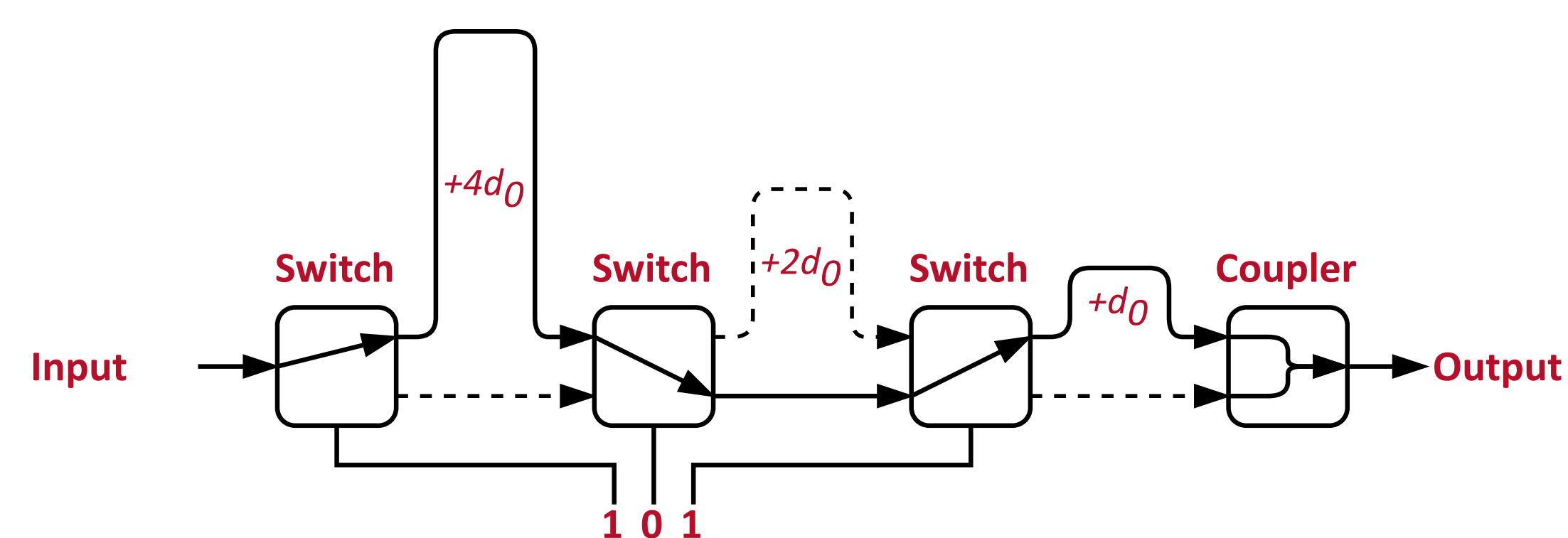


Fig 3 – Active

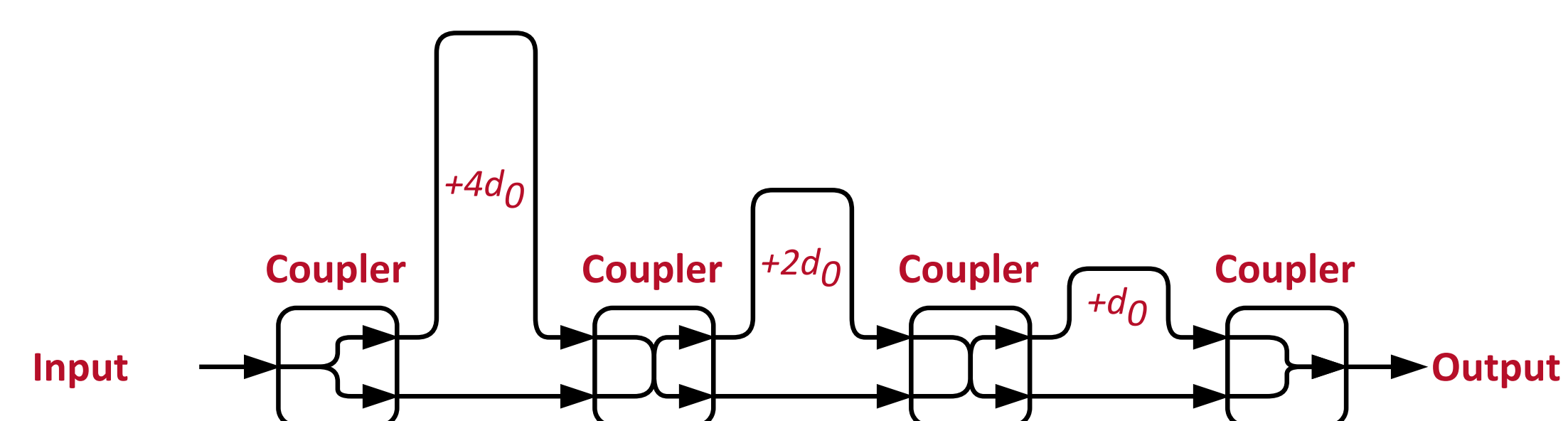


Fig 4 – Passive

4. Validation of FSI System with ADL

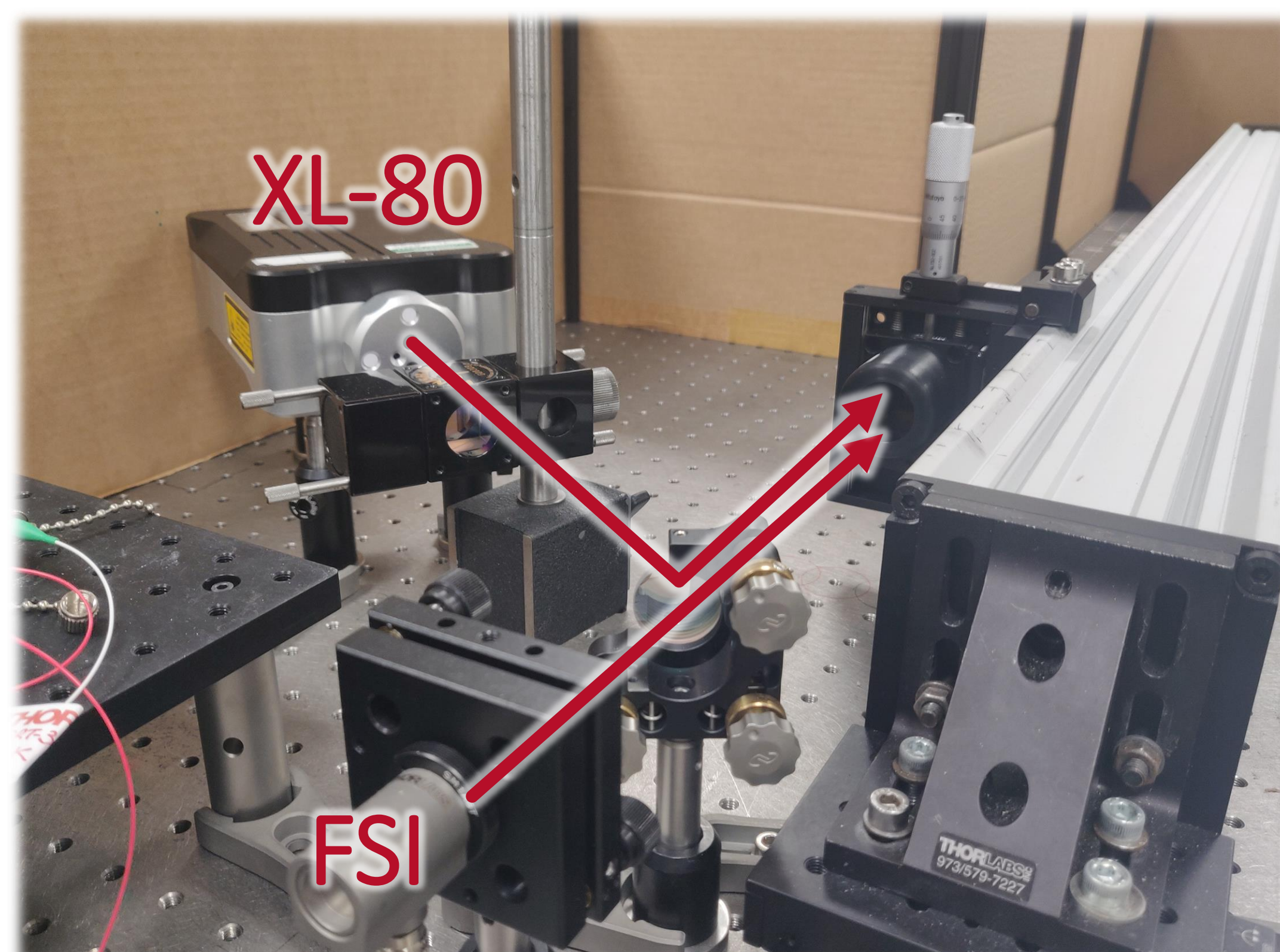


Fig 5 – Renishaw XL-80 and FSI system respectively measuring position and range, simultaneously

5. Performance Characterisation

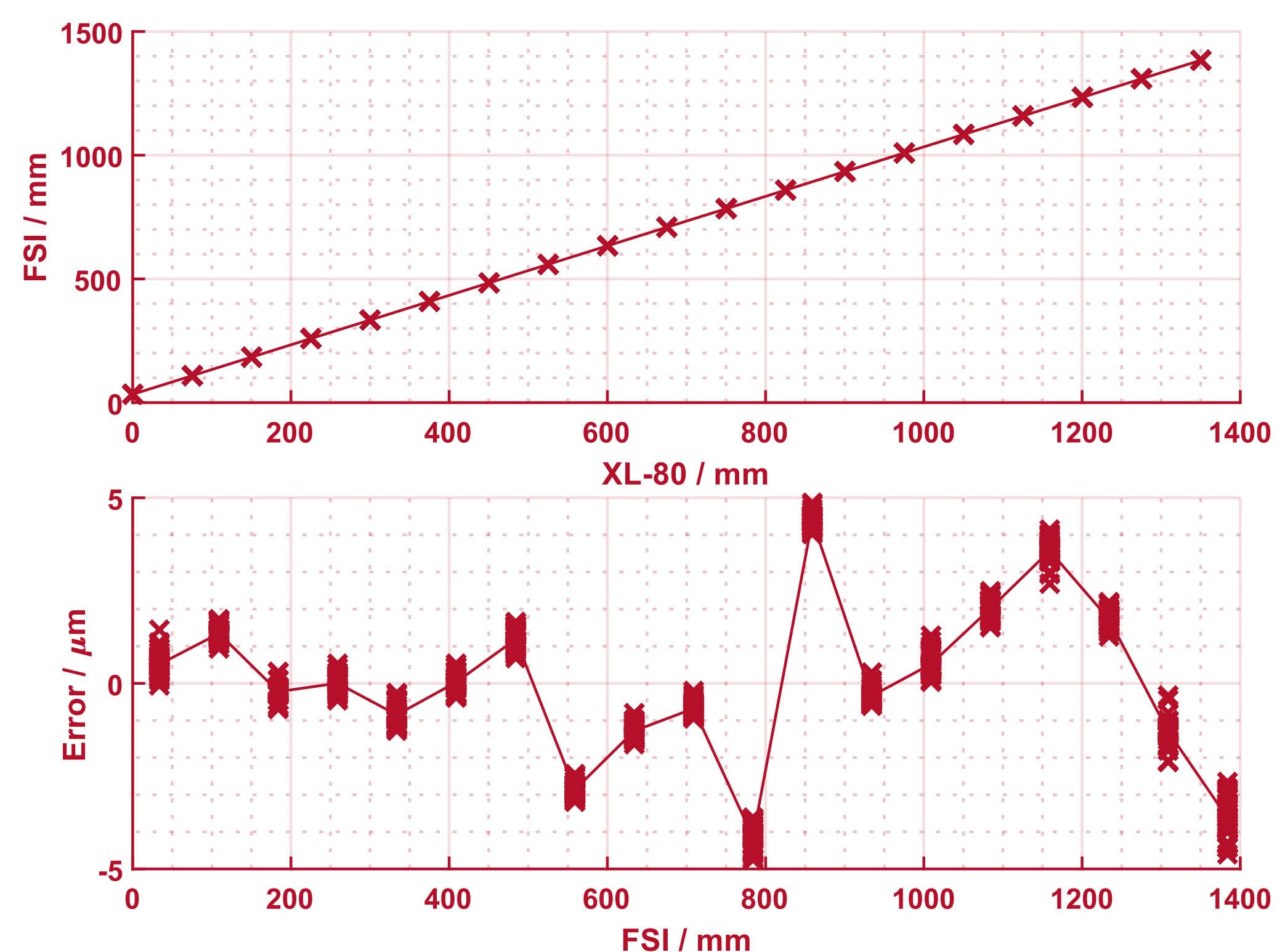


Fig 6 – Characterisation of FSI using a passive ADL, against Renishaw XL-80 differential interferometer

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