Prediction of the amplitude of ultrasound reflection from rough defects

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Ultrasound NDE is well developed for the inspection for defects in nuclear power plant components. It is a highly developed technology, supported by long experience, experimental validations and advanced modelling that provide confidence in its ability to detect and characterise defects of defined severity. However, the qualification of ultrasound inspections for the detection of defects that are expected to be rough is challenging, because of the uncertainty of the strength of the reflection to be expected from the rough surface. It may be possible to anticipate statistical metrics of the surface roughness, but each rough surface is individually different and so scatters differently. The pragmatic solution is usually to apply a large factor of safety on the expectation of the reflection, which is a safe approach but can be very conservative. The authors have developed an alternative approach which delivers the expected amplitude of the reflection from the surface of a rough defect while only knowing the statistics of the roughness. This reduces the conservatism for the inspection yet remains safe. This is achieved using a stationary phase approach with the Kirchhoff Approximation to predict the stochastic expected value of the reflection. The implementation is very fast to calculate and is very accurate. The talk will present the method, its validation, and its implications for use in NDE.