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Digital fast neutron radiography of rebar in concrete

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Neutron imaging has previously been used in order to test for cracks, degradation and water content in concrete. However, these techniques often fall short of alternative non-destructive testing methods, such as gamma-ray and X-ray imaging, in terms of resolution. Further, they can be compromised by the significant expense associated with thermal neutron sources that can often precipitate the need for a reactor which is clearly not portable in the context of the needs of field applications. This paper summarises the results of a study to investigate the potential for transmission radiography based on fast neutrons, in order to determine the presence of heterogeneities in concrete structures such as reinforcement structures, by assessing any variation of transmitted flux between structures containing different materials. Monte Carlo simulations have been performed and the results from these are compared to those arising from practical tests using a 252Cf source. The experimental data have been acquired in real-time using a digital pulse-shape discrimination system that enables fast neutron transmission to be studied across an array of liquid scintillators placed in close proximity to samples under test, and read out in real time. This approach could offer non-destructive testing methods that give less dose, better transportability and better accessibility than other methods previously used for this purpose that are suitable for thick samples where gamma-ray and X-ray methods can be limited.

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