Sample thickness optimization for non-destructive investigation in X-ray radiography

Robert Nshimirimana[1], Graham Daniels[1]

[1]Applied Radiation Department, South African Nuclear Energy Corporation, South Africa

The optimization of an X-ray radiography system involves finding the best values for the parameters that affect the quality of a radiograph such as contrast, penetration, sharpness, and resolution. Beyond parameters like beam voltage, beam current, and exposure time that influence the quality of a radiograph, sample thickness plays a crucial role and requires optimization to achieve the best possible quality radiograph. Thus, the thickness of the sample can be reduced to achieve better beam penetration, or the thickness can be increased for better sampling or beam interaction. Moreover, the physical modification of the sample thickness is a time consuming, labor intensive process and may lead the destruction of the sample, some of which are rare and highly valuable. Those challenges are overcome when the modification of the sample thickness is done in a virtual environment through an optimization process. In this presentation, an X-ray radiography optimization problem of sample thickness is defined and solved using a multi-objective particle swarm optimization algorithm in a virtual environment provided by a radiography simulator. The optimization results achieved in this virtual environment, presented through an approximated Pareto optimal front, demonstrate the potential to obtain an optimal setup for each chosen thickness of the sample.