The 9th International Conference
SPMS 2018
Stochastic and Physical Monitoring Systems
18.6. - 22.6.2018

Contribution ID: **17** Type: **not specified**

Geodesic optimization and acoustic emission localization maps processing

Tuesday, 19 June 2018 15:55 (20 minutes)

We furthermore extend numerical model of localization of acoustic emission (AE) sources on real complex solid bodies based on exact geodesic curves on 3D vessels composed of several parametrized surfaces. The numerical computations are provided via Finite difference, Newton–Raphson, and Fixed-point iteration methods applied to geodesic equations. To speed up computations, some technical improvements and optimizations are proposed. The variable propagation velocity and also the case when the geodesic curve has to bypass given obstacles is also included in the model. These techniques are employed in the real experiments, with aluminium watering can and steam reservoir. The resulting localization maps of AE using length (Δl), or time (Δt) differences, are then processed through the two-dimensional Kernel probability density estimates executed directly on the 3-D surfaces, which give us the most probable areas of the AE source positions. The placement of piezo-ceramic AE sensors is outside the central part of the vessel because it can be inaccessible due to possible high temperature or radioactivity, such as in the case of nuclear power station health monitoring. This outward position of all AE sensors can result in a dispersed or attenuated AE waves because of welded intersections of different surfaces. Thus, the change-point analysis of AE signals is also discussed in order to obtain the most precise arrival times of AE events, which is crucial for Δl or Δt localization.

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Session Classification: Acoustic emission