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Advanced power density mapping for FEA simulations of synchrotron accelerator high heat load components

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Accurately simulating the thermal and mechanical effects of undulator power density distribution in high heat load components requires precise power implementation in finite element analysis (FEA) models. This study presents a novel methodology utilizing intermediate programming to efficiently map complex undulator power density distributions onto FEA models. The approach enables the placement of power density values (e.g., W/mm²) on each element surface while simultaneously calculating the grazing angles based on the insertion device's power source geometry. By automating these processes, the methodology significantly reduces the time and effort required for engineers to implement detailed power distributions in FEA simulations. This advancement not only ensures higher accuracy in modeling but also streamlines the workflow, allowing for faster evaluation and optimization of high heat load components in synchrotron radiation facilities. The proposed framework offers a practical solution for integrating advanced undulator power profiles into engineering analyses, enhancing both efficiency and reliability.

Footnotes

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