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CETASim: A numerical tool for beam collective effect study in storage rings

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We developed a 6D multi-particle tracking program CETASim in C++ programming language to simulate intensity-dependent effects in electron storage rings. The program can simulate the collective effects due to short-range and long-range wakefields for single and coupled-bunch instability studies. It also features to simulate the ion interactions with the trains of electron bunches, including both fast ion and ion trapping effects. As an accelerator design tool, the bunch-by-bunch feedback is also included so that the user can simulate the damping of the unstable motion when its growth rate is faster than the radiation damping rate. The particle dynamics is based on the one-turn map, including the nonlinear effects of amplitude-dependent tune shift, high-order chromaticity, and second-order momentum compaction factor. When required, a skew quadrupole can also be introduced, which is very useful for the emittance sharing and the emittance exchange studies. This paper describes the code structure, the physics models, and the algorithms used in CETASim. We also present the results of its application to the PETRA-IV storage ring.

Footnotes

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Paper preparation format

LaTeX

Region represented

Europe

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