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Automatic retuning of superconducting linacs using LightWin

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Reliability is an important feature for high power particle accelerators. This is particularly true for Accelerator-Driven Systems (ADS), for that every beam interruption can strongly affect the availability of the nuclear reactor.

Many of these outages come from the loss of accelerating cavities or of their associated systems. Cavity failures can be compensated for by retuning other cavities of the linac. Finding the ideal compensation settings is however a difficult challenge that involves beam dynamics and multi-objective optimisation, and which raises very different issues according to the linac under study. For instance in the SPIRAL2 linac, a lot of cavities are mobilized for the compensation and the search space has a very high number of dimensions. Plus, it has quite low margins on the longitudinal acceptance. Linacs for ADS (such as the Japan Atomic Energy Agency ADS or MYRRHA) have a specific fault-tolerance design which facilitate the optimisation, but cavities have to be retuned in a few seconds.

Hence we developed LightWin, a tool to automatically and systematically find compensation settings for every cavity failure of any given linac. In this study, we will present LightWin's latest developments as well as the compensation strategies that we developed for SPIRAL2 and ADS linacs, both from a beam dynamics and a mathematical point of view.

Footnotes

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