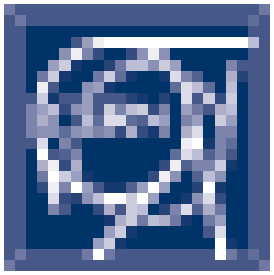

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Tutorial on Optimal Controller

Monday, 10 October 2005 16:40 (45 minutes)

The designer of an RF control system will be aiming for the best possible control of the cavity fields that is possible. Optimal control deals with the problem of finding a control law for a given system such that a certain optimality criterion is achieved. In control theory the control that minimizes a certain cost functional is called the optimal control. The problem formulation usually also contains constraints.

For rf control the goal is usually to regulate the accelerating field to the required stability (or better if possible) with the available rf power. Contraints usually include robustness against parameter variations, rf power limititations, minimizing the trip rate (i.e. maximum availability of the accelerator), maximizing the lifetime of the components, fast recovery from faults, and other operational aspects.

Important for the quality of field control are also the cavity field detectors, the beam diagnostics, the actuators available for control, the perturbations to be controlled and the choice of the controller. The controller usually applies fast control to the klystron drive (low level rf) and slow and fast control to the cavity frequency tuners. Design choices for fast rf control include amplitude and phase versus IQ-control, analog versus digital, self-excited loop versus generator driven and individual cavity control versus control of the vector-sum. A combination of feedforward for repetitive errors and feedback for stochastics errors is used. Slow drifts are often corrected by beam based rf feedback.

The tutorial will present the definition of optimality in control theory and considerations for optimal control for accelerators. Design choices will be discussed and compared.
A concept for the optimal controller will be developed.

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