TECHNOLOGICAL ISSUES OF WIRE COMPENSATORS
A collection of Ideas

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SLAC, LARP Mini-Workshop on Beam-Beam Compensation 2007
MOTIVATION and RESULTING REQUIREMENTS
Outline

1. MOTIVATION and RESULTING REQUIREMENTS

2. IMPLEMENTATION GUIDELINES
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3. REMAINING NOISE
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4. CONCLUSIONS
A DC compensation either optimizes normal or pacman bunches.

An intermediate DC current level improves the nominal and does not harm the extreme (!) PACMAN bunches.

A pulsed compensation must follow the bunch pattern:
- max risetime: 374ns
- average pulse frequency: 439 kHz.

At these frequencies the wire acts like an inductivity of L=800nH.

System must be flexible to adapt to different bunch patterns and to decreasing beam current during one store.

Any turn to turn jitter causes emittance growth. (no growth from Low or high frequencies (compared to the synchrotron frequency).

Emittance growth for white gaussian noise.

- Therefore a turn-to-turn precision of $< 3mA$ ($\Delta \epsilon < 10\%$ in 20h)
Use low Ω cabling (we want current, not power!)

Use the inductivity: $\dot{I} = \frac{U}{L}$ to define the current slope and the cable's resistivity to define the plateau:

That doesn’t really create a straight line, but that doesn’t matter

required Voltage: 270V
This corresponds to a timing precision of 0.02ns.

Take running times into account; Reflections disturb the pattern
→ match on generator side (to have no reflections going back to the wire)
→ Do not match on load side (would require high power).
That's not what we need
That's what we need
40MHz sin shape
There is a difference between head/tail and center. This should not be a problem.
Error of 3mA corresponds to a timing error of 30ps. The ratio time/error is nonlinear and needs to be properly simulated.

An amplitude modulated Sin shape is technological easier to implement/controll

Phase noise measurement allows to measure the error

Amplitude modulation prohibits a high Q resonator

The pulser will be working on a standard 50 Ω cable and transformer (passiv) at the wire.
Transverse Feedback might be needed anyway to cure other problems.

J.P’s 3-turn delay feedback: Measure the error on the wire and compensate for it $3 \cdot N$ turns later. Should be compatible with the RF approach.
A pulsed wire is good, but make sure to keep a DC option as a fallback option.

There is hope again with Fritz’s RF idea.

I like J.P’s feedback.

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