Linac studies with SLEPT

K. KUBO

SLEPT,*
Linac tracking simulation program.
Named recently.
Original version was written in 1993~1995.
(NLC-Note-14)
It had been used sometimes since then,
but mostly sleeping.

We are trying to connect it with other codes
for other parts of LC. (SAD, CAIN, etc.,
from DR exit to IP)
“SAD script” is used for this purpose.
(No results from the connection yet.)

Some results using SLEPT alone are
presented here.

* may stands for
Simulation program for Low Emittance by Phase space Tracking
Errors.

- Injection
- Quad, Cavity misalignment
  - Independent (Ω)
  - 'ATL' (AT)
- \( Q - \text{BPM}_q \) misalignment (unknown offset)
  - Independent (Ω)
- Cavity-BPMc
  - Independent (Ω)
- \( \text{BPM}_q \) resolution
Correction (Feedback)

Simulated

- Quad 'simple' alignment
  make \( \sum (\text{BPM} \text{ read})^2 \) minimum.

- Cavity alignment
  make BPMc read zero

- Fast orbit feedback
  pairs of steerings at several places /linac

Not simulated yet

'Advanced' correction, feedback

Dispersion free

\( \varepsilon \)-bump

intra pulse (train) feedback at IP

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<table>
<thead>
<tr>
<th>Error</th>
<th>Correction</th>
<th>$&lt;\text{Emitt}&gt;$ (E-8 m-rad)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injection 0.5 sigma</td>
<td>None</td>
<td>2.411</td>
</tr>
<tr>
<td>Q misalignment 10 nm</td>
<td>None</td>
<td>2.430</td>
</tr>
<tr>
<td>Cavity-BPM 5 micron</td>
<td>Beam-Cavity alignment</td>
<td>2.348</td>
</tr>
<tr>
<td>Q-BPM 2 micron</td>
<td>1-to-1 steering</td>
<td>2.269</td>
</tr>
<tr>
<td>Q-BPM 2 micron Cavity-BPM 5 micron</td>
<td>Simple Q alignment Beam-Cavity alignment</td>
<td>2.483</td>
</tr>
<tr>
<td>AT=2.5E-9 (ATL law)</td>
<td>Simple Q alignment Beam-Cavity alignment</td>
<td>2.528</td>
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<tr>
<td>Q-BPM 2 micron Cavity-BPM 5 micron</td>
<td>Fast orbit steering 10 pairs/linac</td>
<td>2.644</td>
</tr>
</tbody>
</table>
No correction, No cavity move

\[ Y = M_0 + M_1 x + ... + M_8 x^8 + M_9 x^9 \]

<table>
<thead>
<tr>
<th>( M_0 )</th>
<th>1.9457e-08</th>
</tr>
</thead>
<tbody>
<tr>
<td>( M_1 )</td>
<td>4.3979e-10</td>
</tr>
<tr>
<td>( M_2 )</td>
<td>1.442e-11</td>
</tr>
<tr>
<td>( R )</td>
<td>0.99974</td>
</tr>
</tbody>
</table>

\( e \) (rad.m) vs. Quad misalign. (nm)
Simple Quad alignment

Simple correction
Initial misalign 200 micron
Beam-Cavity 5 micron

\[ Y = M0 + M1 \cdot x + \ldots + M8 \cdot x^8 + M9 \cdot x^9 \]

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>M0</td>
<td>2.3371e-08</td>
</tr>
<tr>
<td>M1</td>
<td>1.1497e-11</td>
</tr>
<tr>
<td>M2</td>
<td>3.6684e-10</td>
</tr>
<tr>
<td>( R )</td>
<td>1</td>
</tr>
</tbody>
</table>

Q-BPM offset error (micron)

Simple alignment
Q-BPM 2 micron
Beam-Cavity: 5micron

\[ y = 2.4925e-08 + 0.17299x \quad R = 0.99976 \]

Emittance (rad-m)

AT (m)
Linac divided into 10, same phase advance.

End of each section.

2 steers + 4 BPM

for orbit correction.

10 seering pairs

\[ \gamma (\text{E-8 rad-m}) \]

Quad misalignment (nm)
10 steering pairs, no misalignment
Quad misalign 30 nm, BPM resolution 0

\[ \gamma \epsilon (\text{E-8 rad-m}) \]

- **No Cavity movement**
- **Beam-Cavity alignment 5 micron**

Number of steering pairs/linac