

# SIXTRACK Postprocessing for TEAPOT Output

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## 1 Introduction

Turn-by-turn tracking data hold a large amount of information that can help to understand the nonlinear motion. In addition to the present postprocessing tools for TEAPOT [1] the SIXTRACK [2] postprocessor is now available for TEAPOT turn-by-turn output through a conversion program. Besides other features this allows an easy Lyapunov exponent analysis of the particle motion, necessary to decide if it is regular or chaotic. All programs needed for conversion and analysis are in directory

```
owl: /rap/lattice_tools/teapot/teasix
```

In this directory a number of subdirectories exist:

<code>bin</code>	executables
<code>example</code>	an example of TEAPOT to SIXTRACK conversion and SIXTRACK postprocessing
<code>sixpost</code>	source code for the conversion program and additional SIXTRACK postprocessing programs
<code>sixtrack</code>	SIXTRACK source code (scalar version) containing the main postprocessor

## 2 Transforming TEAPOT Output into SIXTRACK Postprocessing Input

To transform the TEAPOT turn-by-turn output on file unit 8 into SIXTRACK postprocessing input run

```
owl: /rap/lattice_tools/teapot/teasix/bin/tpot2six
```

The program will ask for the phase space dimension. The turn-by-turn coordinates of the particles in fort.8 will be transferred into file units 90 (1st and 2nd particle), 89 (3rd and 4th particle) etc. in the SIXTRACK format. To perform a Lyapunov analysis the initial particle distances of each pair must be small ( $10^{-5}$  to  $10^{-8}$  mm was found to be a good choice for all practical purposes [3]).

### 3 Data Analysis with SIXTRACK

The SIXTRACK postprocessing parameters must be given in file unit 3 (cf. the example, for details Ref. [2]). The SIXTRACK postprocessor runs with

```
owl: /rap/lattice_tools/teapot/teasix/bin/six
```

Depending on the parameters given in unit 3, various output files can be produced. A summary of the postprocessing can be found in fort.6. If graphical output is chosen a postscript file fort.20 will be created. With the SIXTRACK produced output some further analysis is possible with programs in the bin directory:

<b>tune</b>	computes the tune dependent on amplitude or momentum (by M. Giovannozzi)
<b>sixpaw</b>	prepares a file from the data in the fort.90-x files that can be read and viewed with paw++
<b>sixpost</b>	takes the fort.90-x files and computes the phase advance tune averaged over some turns
<b>setvzero</b>	sets the vertical components of the pair coordinates zero, was made to examine the Lyapunov behavior for motion with $z \approx 0$
<b>findxmax</b>	finds the maximum horizontal position in the SIXTRACK binary files fort.90-x

Normally, three beta function per degree of freedom (thus coupling included) are contained in the SIXTRACK binary files fort.90-x. Since the conversion program cannot provide these beta functions some results have to be used with care (e.g. smear and nonlinear invariants).

### References

- [1] L. Schachinger and R. Talman, "Manual for the program TEAPOT, noninteractive FORTRAN version" (1995).
- [2] F. Schmidt, "SIXTRACK, version 1.1, single particle tracking code treating transverse motion with synchrotron oscillations in a symplectic manner", CERN SL/90-52 (AP) (1990).  
<http://hpariel.cern.ch/frs/Documentation/six.ps>
- [3] F. Schmidt and M. Giovannozzi, private communication.