European Organization for Nuclear Research
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CERN/xx/xx
Updated April 2018

SixDesk

Version 1.0

the Simulation Environment for SixTrack

User's Reference Manual

R. De Maria, M. Giovannozzi, E. McIntosh, A. Mereghetti, F. Schmidt, I. Zacharov

Updated by: P. D. Hermes, D. Pellegrini, S. Kostoglou

Abstract

SixTrack [1, 2, 3] is a single particle tracking code widely used at CERN. One of its most important applications is the estimation of the dynamic aperture available in large storage rings like the Large Hadron Collider (LHC) or the Future Circular Collider (FCC). These studies require massive computing resources, since they consist of scans over large parameter spaces probing non-linear beam dynamics over long times. The SixDesk [4, 5] environment is the simulation framework used to manage and control the large amount of information necessary for and produced by the studies.
This document updates the previous documentation, and describes how massive tracking campaigns can be performed with SixTrack starting from a MadX "mask" file. The SixDesk environment is an ensemble of shell scripts and configuration files, aimed at easing the everyday life of the user interested in performing large parameter scans with SixTrack.

Geneva, Switzerland
April 24, 2018

Acknowledgement

Some acknowledgements.

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Chapter 1

Introduction

SixTrack [1, 2, 3] is a tracking code for simulating transverse and longitudinal single particle beam dynamics. Tracking is treated in a full six–dimensional way, including synchrotron motion, in a symplectic manner. SixTrack is widely used at CERN for predicting dynamic aperture in large storage rings [6] like the Large Hadron Collider (LHC) [7] or its upgrade as foreseen by the High Luminosity LHC Project (HL-LHC) [8, 9].

The code was extended [10] to predict the performance of a collimation system in terms of loss pattern and cleaning inefficiency. Hence, SixTrack is routinely used nowadays also for addressing the performance of existing cleaning systems, like those of the LHC [11] or of the Relativistic Heavy Ion Collider (RHIC) at BNL [12], or new ones.

The code is in continuous development [13, 14], not only to improve the accuracy of the tracking models, but also including the dynamics introduced by novel accelerator technologies, like electron lenses or powered wires for the compensation of beam–beam long range effects or christal collimation.

The accelerator dynamic aperture is studied scanning the beam phase space in presence of non-linear forces, like the kicks introduced by long range beam–beam interactions or multipolar components of magnetic fields. Moreover, the scan could be also performed varying the machine configurations. The SixDesk [4, 5] environment gives the users of SixTrack a mean to handle the large amount of files to be treated.

1.1 Overview

1. SixTrack input generated by MadX (`fort.2`,`fort.8`, `fort.16`); then, run SixTrack; then, collect results (`fort.10`) and analyse them via SixDB;
2. inner loops (i.e. controlled by `sixdeskenv`) and outer loops (i.e. controlled by `scan_definitions`);

1.2 Work Flow

Show workflow of production of results, both for BOINC (including "processed" folder) and HTCondor.

Retrieval of results depends on the submission platform:

- `run_results`: BOINC
- `run_status`: HTCondor, HTBoinc

1.3 The BOINC Platform for Volunteering Computing

BOINC vs local batch system (e.g. HTCondor)

1.4 Pre-requisites

SIXDESK is native to `lxplus.cern.ch`. Hence, for running in such an environment, the user does not need to set up anything. On the contrary, in case of a local machine or other distributed resources,

Table 1.1: Pre-Requisites

Component	**reason**
kerberos	to renew/check credentials via `klist` and `kinit`
AFS (local mount)	retrieval of optics files submission to BOINC via spooldir
HTCondor (local installation)	submission of jobs to local batch system
`python2.7`	`SixDB` computation of floating point scan parameters

Chapter 2

New Features

This chapter illustrates the new features implemented in SixDesk from the user point of view.

2.1 External Scans

Original work by: P. .D. Hermes, D. Pellegrini
Updated by: A. Mereghetti

"Internal scans" are the scans handled by SixDesk directly from the input contained in the `sixdeskenv` file.

Chapter 3

Giudelines and Common Pitfalls

3.1 Choice of Platform

HTCondor is convenient when:

1. results should be collected quickly. This can be the case when the user has short time to collect data or the simulation set-up is being defined. In the second case, indeed, one does not want to wait too long for proceeding;

2. short or few jobs per study. This can be the case when re-submission of selected cases is necessary, e.g. to complete a study when few points in the scan are missing;

The BOINC platform for volunteer computing is convenient in case of large simulation campaigns, i.e. when simulations are long or they are in high number (e.g. hundreds of thousands of jobs).

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