Development of a Virtual Accelerator for Sirius





MINISTÉRIO DA
CIÊNCIA, TECNOLOGIA,
NOVAÇÕES E COMUNICAÇÕES

X. R. Resende, A. H. C. Mukai, L. N. P. Vilela, I. Stevani Brazilian Synchrotron Light Laboratory (LNLS), Campinas, Brazil

Abstract

A virtual accelerator is being developed for Sirius, the new 4th generation synchrotron light source being built in Campinas, Brazil. The virtual accelerator is an on-line beam simulator which is integrated into EPICS control system. It consists on a command line interface server with a channel access (CA) layer and with an in-house developed tracking code library written in C++ for efficiency purpose. The purpose of such server is to facilitate early development and testing of high level applications for the control system.

VACA - Virtual Accelerator with Channel Access

- ► VACA is written in Python3.
- ► High level programming language allows for rapid development
- ➤ Python language works as a binding layer between the two main core modules: a CA server and a tracking code for simulations. The python package PCasPy is used as the CA server module.
- ▶ PVs implemented in VACA have a prefix "VA-" indicating that they represent virtual process variables.
- ► Use of trackcpp: developed at LNLS by the accelerator physics group.
- ► Trackcpp is converted to Python package with Swig3.0

```
ximenes@lnls208-linux:~$ sirius-vaca.py
                     Virtual Accelerator with Channel Access server
                    Version 0.15.2
                    LNLS Accelerator Physics Group
                    Documentation: https://github.com/lnls-fac/va
                     Prefix: VA-
                    Number of SI pvs: 3472
                    Number of BO pvs: 836
                     Number of LI pvs: 6
                     Number of TB pvs: 147
                    Number of TS pvs: 125
2016-10-05 09:59:03.908: start LI V00
2016-10-05 09:59:03.909: init epics sp memory for LI pvs
2016-10-05 09:59:03.910: start BO_V02A
2016-10-05 09:59:03.914: start SI_V17_01
2016-10-05 09:59:03.925: start TB_V01
2016-10-05 09:59:03.930: start TS_V01
                               waiting model initialisation
2016-10-05 09:59:03.965: start
2016-10-05 09:59:03.981: init
                               epics sp memory for TS pvs
2016-10-05 09:59:03.981: init
                               epics sp memory for TB pvs
2016-10-05 09:59:04.027: calc
                               transport efficiency for TB_V01
2016-10-05 09:59:04.327: calc
                               closed orbit for BO_V02A
                                linear optics for BO_V02A
2016-10-05 09:59:04.367: calc
2016-10-05 09:59:04.435: calc
                                equilibrium parameters for BO_V02A
2016-10-05 09:59:04.743: calc
                               beam lifetimes for BO_V02A
                               closed orbit for SI_V17_01
2016-10-05 09:59:04.803: calc
2016-10-05 09:59:04.856: calc
                                ejection efficiency for BO_V02A
                                linear optics for SI_V17_01
2016-10-05 09:59:04.945: calc
                                equilibrium parameters for SI_V17_01
2016-10-05 09:59:05.105: calc
2016-10-05 09:59:05.756: calc
                                beam lifetimes for SI_V17_01
                               epics sp memory for BO pvs
2016-10-05 09:59:05.910: init
2016-10-05 09:59:09.269: calc
                                injection efficiency for BO_V02A
                               ejection efficiency for BO_V02A
2016-10-05 09:59:09.271: calc
2016-10-05 09:59:09.431: calc
                                transport efficiency for TS_V01
                                epics sp memory for SI pvs
2016-10-05 09:59:09.638: init
2016-10-05 09:59:22.194: calc
                                on axis injection efficiency for SI_V17_01
2016-10-05 09:59:22.928: start starting server
```

Figure 1: Screen printout of a command line terminal showing a running instance of VACA with the display of its banner and useful information.

Virtual IOCs

- ➤ si_bpm,bo_bpm,ts_bpm,tb_bpm: they serve BPM positions that are read from VACA, adding emulated measurement fluctuations.
- ➤ si_current,bo_current: they provide simulated beam currents with fluctuations. Touschek, elastic and inelastic simulated lifetimes are affected by variations of associated parameters such as RF gap voltage and reduced acceptance due to closed orbit variations.
- ➤ **si_ps,bo_ps,ts_ps,tb_ps**: provide read/write access to PVs that correspond to power supplies with associated magnet excitation curves.
- si_rf,bo_rf: implement radio frequency process variables.
- **si_tune**: emulation of the tune measurement IOC.
- ➤ si_beamsize, bo_beamsize: emulation of beam size measurement IOC.

Conclusions

- ▶ Details of the pulsed signals during injection and ejection processes need be considered.
- ► Approximate coupling expressions for beam size estimates should be substituted by Ohmi's envelop formalism[?] in trackcpp,
- ► A cleaner separation between VACA and vIOCS is in order. At this points a few excitation curves are implemented in VACA since it has not been decied yet where they will finally be located in the CS. They can either be moved to the IOCs, in case they should be moved to the vIOCS for the VA, or moved to some configuration database service.
- Considerations on moving from EPICS database records PCASPy for vIOCS developments. This may simplify the process of writing and deploying applications.
- ➤ Recently a few DISCS[?] services have been adopted. In particular, the use of its naming service allowed for a standardization of how to name devices and PVs. A major revision of PV names has taken place recently. VA should be modified to contemplate the new PV name standard.