



VieVS

Vienna VLBI and Satellite Software

How to simulate VLBI observations with VieVS

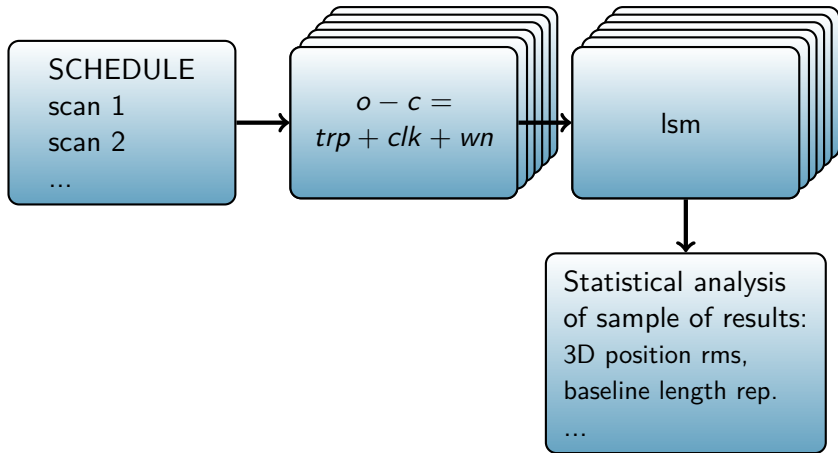
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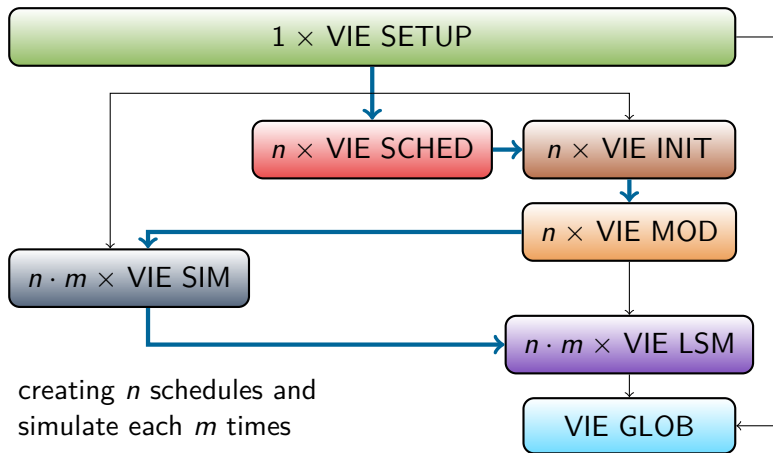
Why simulations?

- generate artificial delay observables - useful to test
 - new scheduling strategies
 - different station network geometries
 - antenna specifications
 - the influence of systematic effects, e.g. source structure
- generate zero input NGS files - useful to test the impact of different models in the analysis

Simulation procedure



Implementation in VieVS



creating n schedules and
simulate each m times

What is simulated?

$$o - c = \underbrace{(zwd_2 \cdot mf(el_2) + clk_2)}_{station2} - \underbrace{(zwd_1 \cdot mf(el_1) + clk_1)}_{station1} + wn_{bsl}$$

What is simulated? troposphere zenith wet delay

$$o-c = \underbrace{\left(zwd_2 \cdot mf(el_2) + clk_2 \right)}_{station2} - \underbrace{\left(zwd_1 \cdot mf(el_1) + clk_1 \right)}_{station1} + wn_{bsl}$$

zwd - troposphere zenith wet delay

- provided by a turbulence simulator
- simulated per station
 - based on the approach by Nilsson et al. (2007)
 - accounts for spatial and temporal correlation

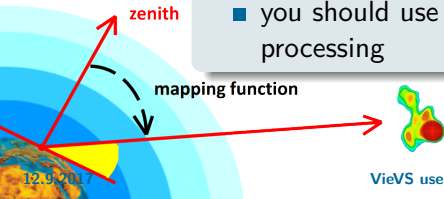


What is simulated? mapping function

$$o - c = \underbrace{\left(zwd_2 \cdot mf(el_2) + clk_2 \right)}_{station2} - \underbrace{\left(zwd_1 \cdot mf(el_1) + clk_1 \right)}_{station1} + wn_{bsl}$$

$mf(el)$ - mapping function (elevation)

- simulated per station
- you should use the same mf for creation and processing



What is simulated? station clock

$$o-c = \underbrace{\left(zwd_2 \cdot mf(e_{l_2}) + \text{clk}_2 \right)}_{\text{station2}} - \underbrace{\left(zwd_1 \cdot mf(e_{l_1}) + \text{clk}_1 \right)}_{\text{station1}} + wn_{bsl}$$

clk - station clock

- simulated as sum of a random walk and an integrated random walk process
- simulated per station
 - according to Herring et al. 1990



What is simulated? white noise

$$o-c = \underbrace{(zwd_2 \cdot mf(e_2) + clk_2)}_{station2} - \underbrace{(zwd_1 \cdot mf(e_1) + clk_1)}_{station1} + wn_{bsl}$$

wn - white noise

- simulated per baseline

Before running VIE_SIM

- Do not use any outlier files
- Make sure to set the quality code limit to >9 (it is important that all observations are used for the simulation)
- After the simulation you can process the simulated data with any options you like

Where is the output?

- simulated NGS files are stored to *VieVS/DATA/SIM/year*
- in *DATA/LEVEL4/your_dir* you find all simulated parameters
 - *yourSessionName_azel*: contains all azimuth, elevation and mjd information
 - *yourSessionName_mf*: contains all mapping function information
 - *yourSessionName_cov*: contains the simulated correlation matrices
 - *yourSessionName_sim*: contains the simulated values for *swd*, *clk* and *wn*

Parameters

- tropospheric parameters
 - C_n refractive index structure constant
 - H effective height of wet troposphere
 - vn, ve components of the wind vector
 - $wzd0$ a priori zenith wet delay
 - $dhseg$ correlation interval
 - dh stepwidth for the numerical integration
- clock
 - ASD Allan Standard Deviation
 - @ at this amount of minutes minutes
- white noise
 - wn white noise for quasars
 - wn_{sat} white noise for satellites

Turbulence file

- holds individual parameters for each station
- stored in *VieVS/DATA/TURB*

# station	Cn	H	vn	ve	wzd0	dhseg	dh	ASD	@	wn	wn_sat
BADARY	1.37	2000	0.0	8.0	250	2	200	1e-14	50	32	50
TSUKUB32	3.45	2000	0.0	8.0	250	2	200	1e-14	50	32	50
KOKEE	1.39	2000	0.0	8.0	250	2	200	1e-14	50	32	50
NYALES20	0.65	2000	0.0	8.0	250	2	200	1e-14	50	32	50
HOBART12	1.60	2000	0.0	8.0	250	2	200	1e-14	50	32	50
FORTLEZA	2.46	2000	0.0	8.0	250	2	200	1e-14	50	32	50
YEBES40M	1.48	2000	0.0	8.0	250	2	200	1e-14	50	32	50
HARTRAO	1.34	2000	0.0	8.0	250	2	200	1e-14	50	32	50
TIGOCONC	2.08	2000	0.0	8.0	250	2	200	1e-14	50	32	50
WETTZELL	1.50	2000	0.0	8.0	250	2	200	1e-14	50	32	50
ZELENCHK	1.86	2000	0.0	8.0	250	2	200	1e-14	50	32	50
ONSALA60	2.19	2000	0.0	8.0	250	2	200	1e-14	50	32	50



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Lecture VLBI Simulation

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