

# **CORTEX Validation Workshop**

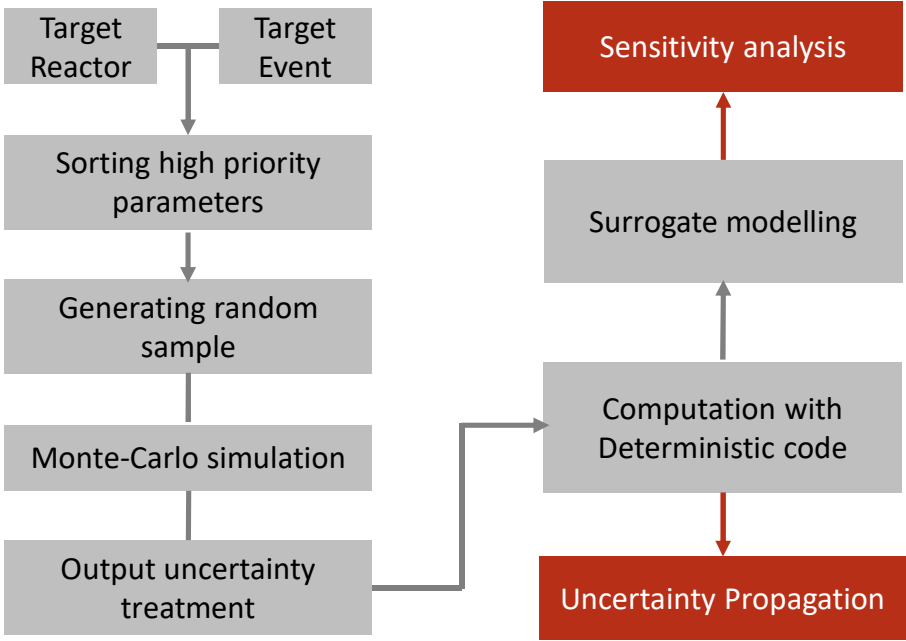
## **Uncertainty Propagation: Data Preparation & Post Processing**

**SOOBEEN YUM**

**Technical University of Munich**

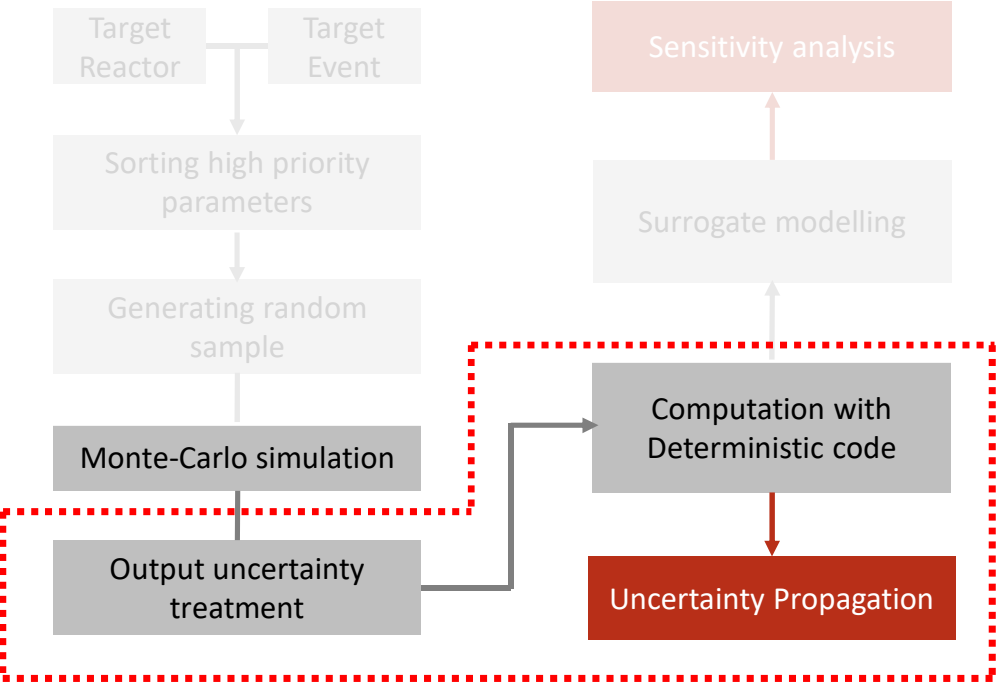
**Mar 13, 2020**

# Work Flowchart

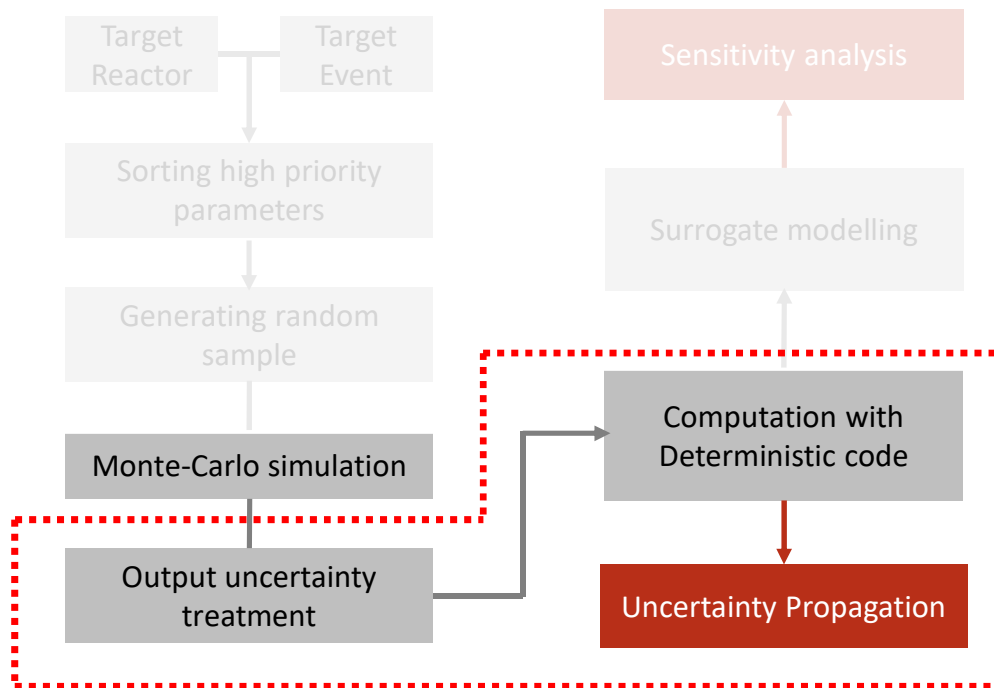


# Work Flowchart

The main topic for the ‘validation’



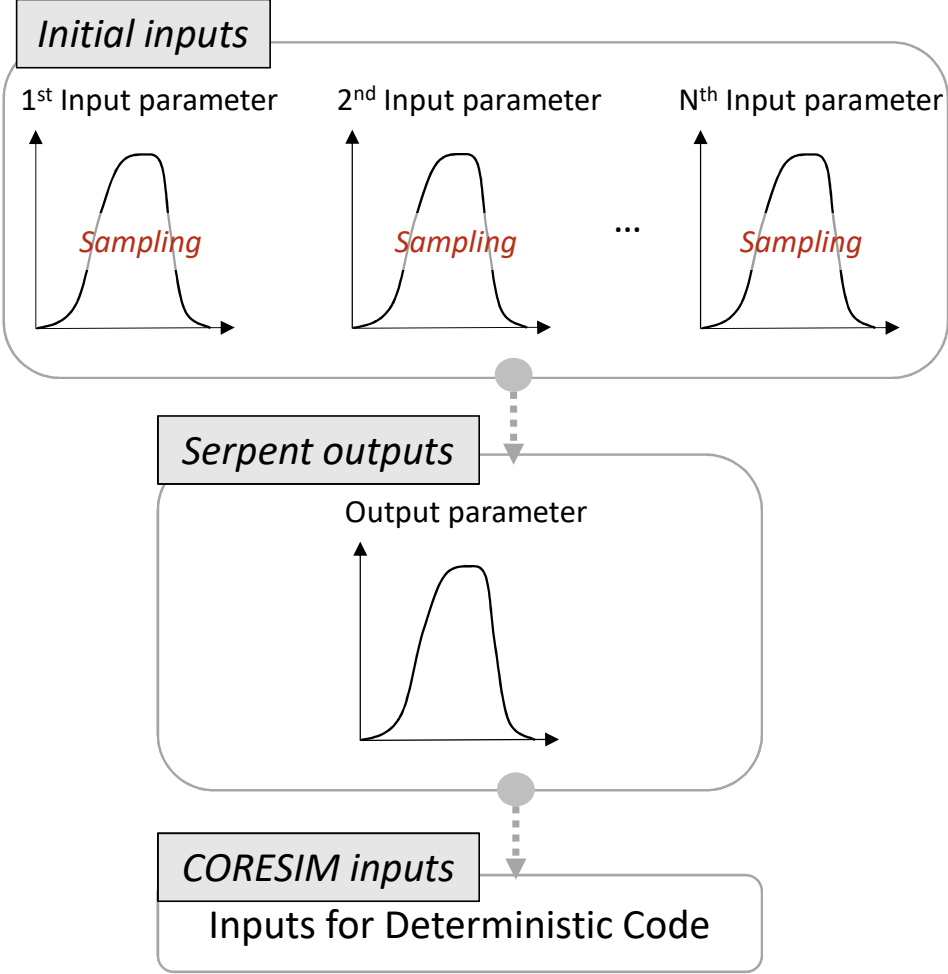
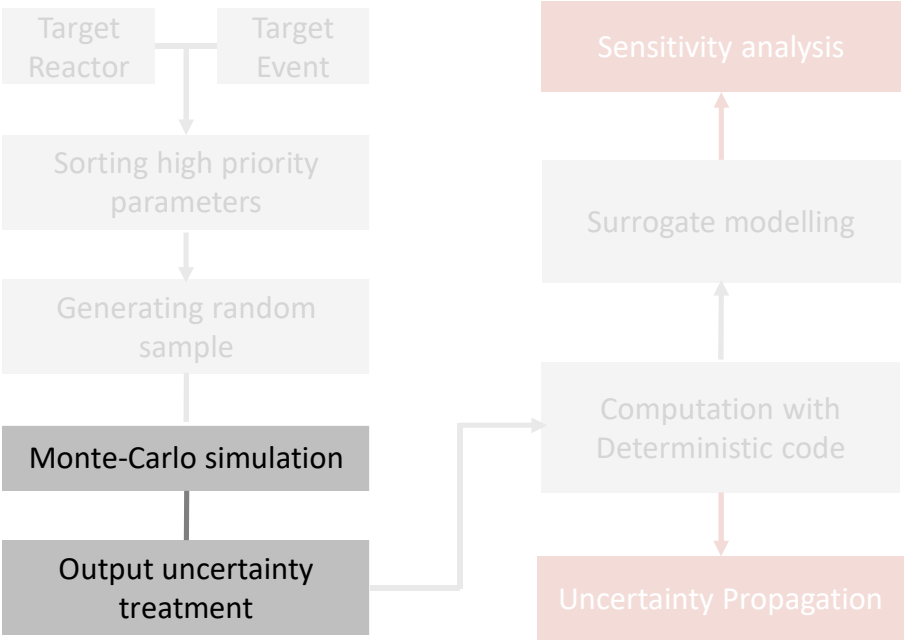
## Work Flowchart



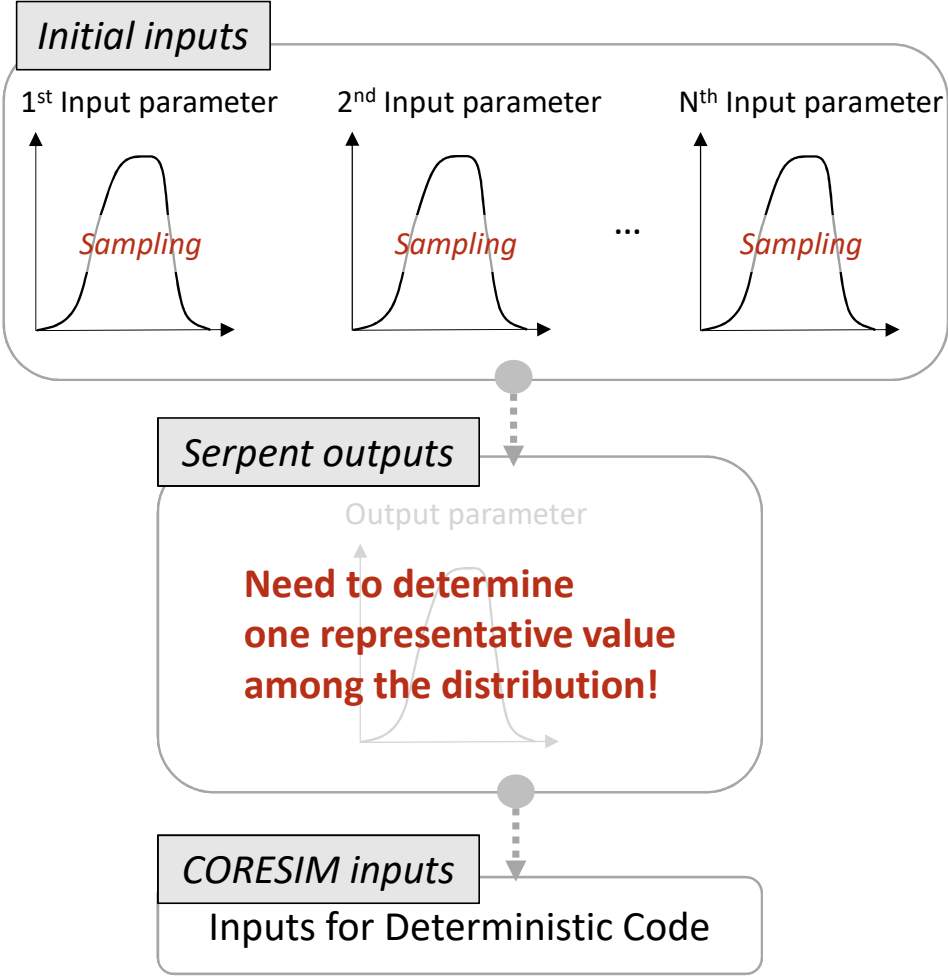
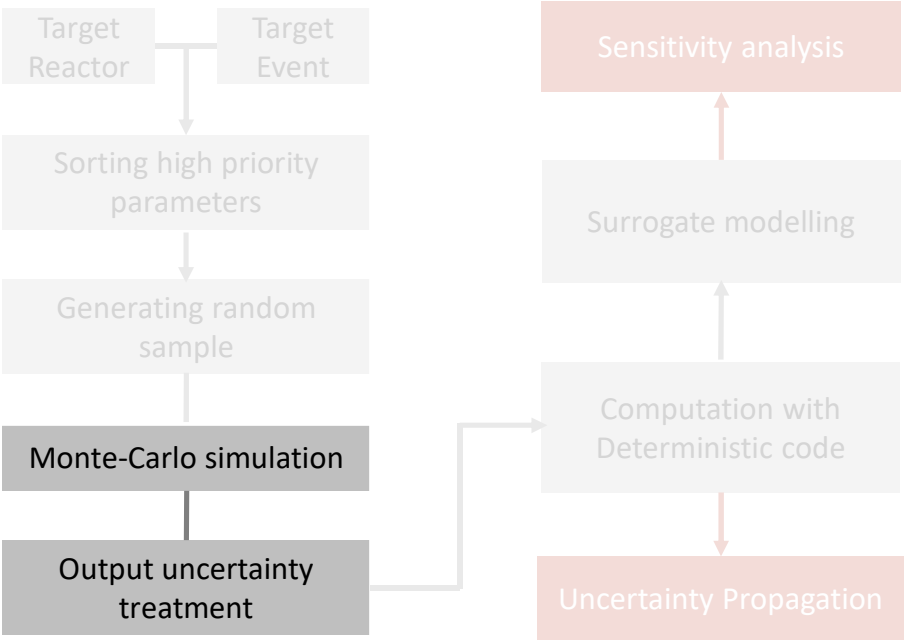
### Assumptions

- *Modelling of the core (x-,y-,z-): 43 x 113 x 30*
- *Mesh size (y- direction)  
Around oscillating area: 2mm  
Other area: 3cm*
- *Neutron speed → Extracted from  $U_{metal}$  region*

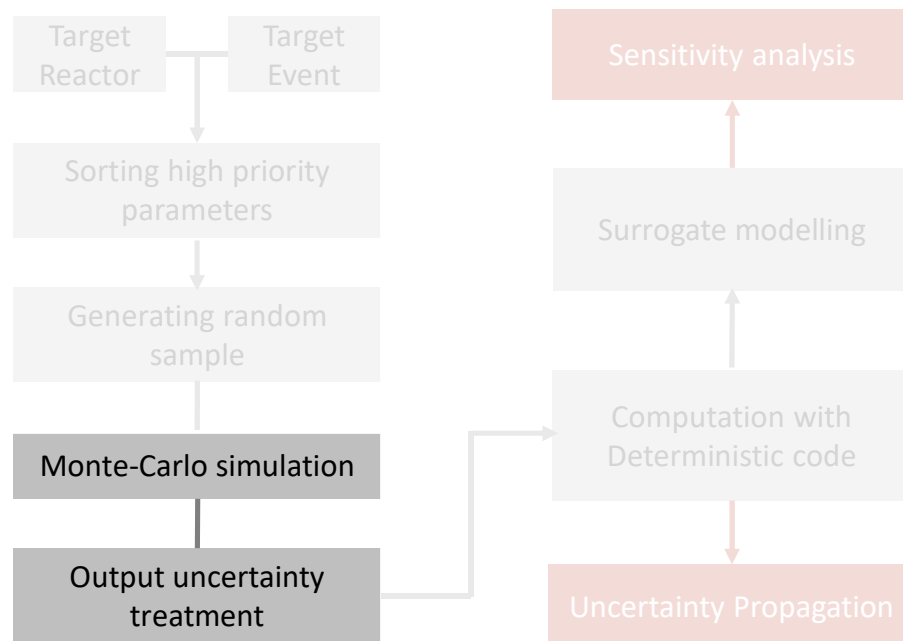
# Serpent Output Post-processing



# Serpent Output Post-processing



# Serpent Output Post-processing



## Resampling Serpent output data

Target output data :

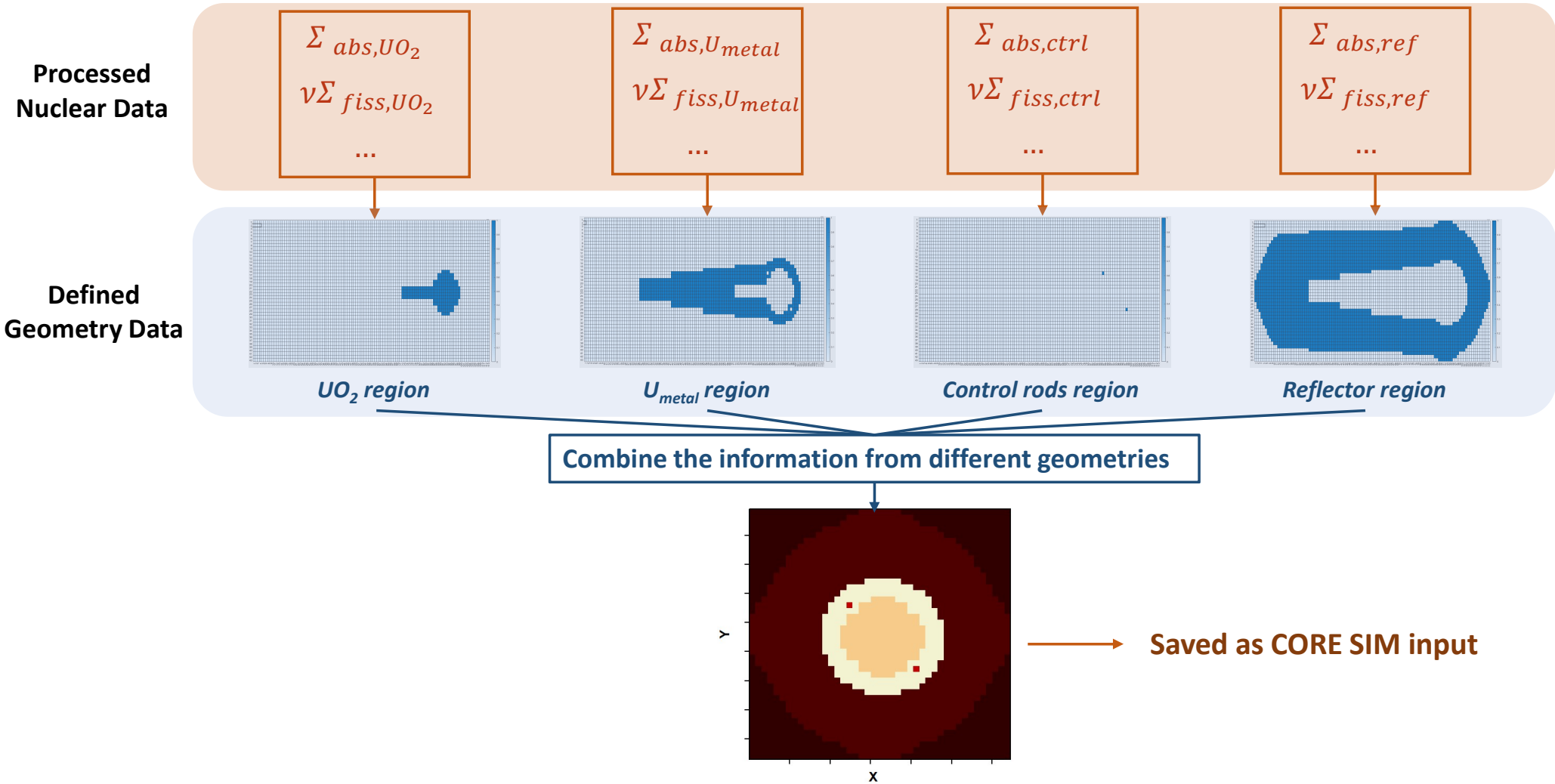
$\Sigma_a, \Sigma_{rem}, \nu\Sigma_f, D, \beta, \lambda, \delta\Sigma_a, \delta\Sigma_{rem}, \delta\nu\Sigma_f$   
-From 7 regions ( $UO_2$ ,  $U_{metal}$ , Ctrl, Reflector)

Output data from  $N$  input sets:

$mean_k \pm error_k (1 \leq k \leq N)$

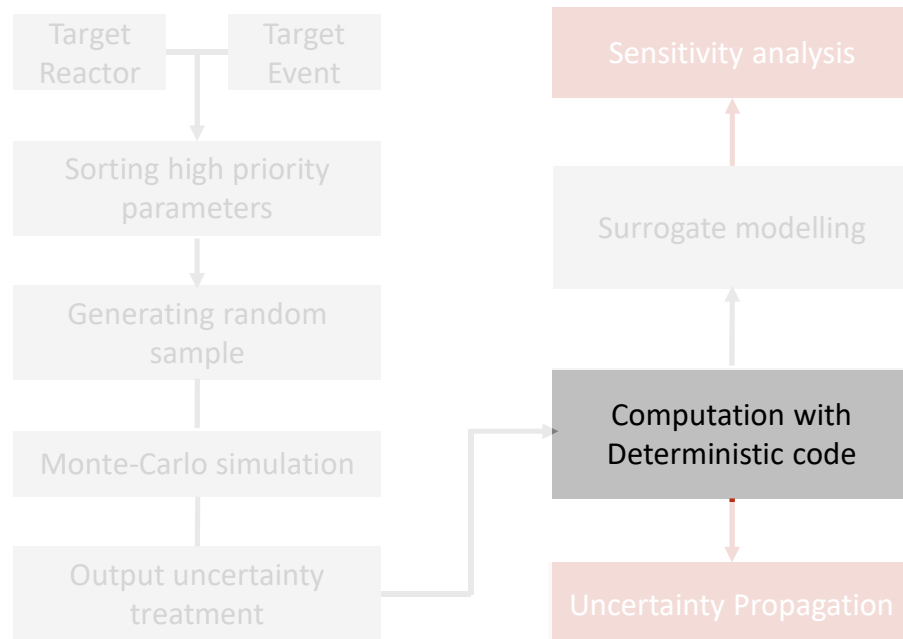
- Modelling normal distribution
- Sampling one value by SRS from distribution

# Serpent Output Post-processing





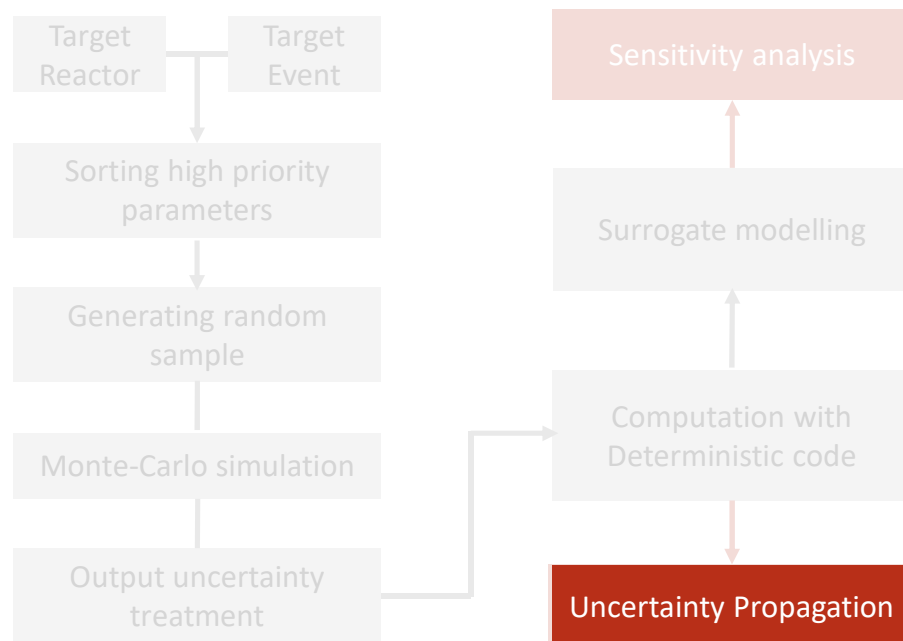
## CORE SIM+ computation



### CORE SIM+ computation with batch process

- *Save the input data (GEOM, XS, DS, dS) needed for the further computation for 1000 cases*
- *1000 times of computation with static solver and noise solver*

# Uncertainty Propagation



## Uncertainty Propagation with CPSD

- *Extract CPSD amplitude and phase data at the detector location*
- *Only 260 cases out of 1000 cases (4<sup>th</sup> order Wilks' formula for two-sided limits)*
- *Find 4<sup>th</sup> largest and 4<sup>th</sup> smallest values which stand for upper limit and lower limit, respectively*

# Practical Exercises

## Uncertainty Propagation with CPSD

- COLIBRI experiment #13 (amplitude = 2mm, frequency = 1Hz)

Name	Date modified	Type	Size
processing	2/27/2020 12:06 PM	File folder	
CPSD.m	2/24/2020 12:56 PM	MATLAB Code	1 KB
File_1.inp_res.m	10/29/2019 11:23 ...	MATLAB Code	445 KB
File_2.inp_res.m	10/29/2019 12:56 ...	MATLAB Code	445 KB
File_3.inp_res.m	10/29/2019 2:30 PM	MATLAB Code	445 KB
File_4.inp_res.m	10/29/2019 4:03 PM	MATLAB Code	445 KB
File_5.inp_res.m	10/29/2019 4:03 PM	MATLAB Code	445 KB
File_6.inp_res.m	10/29/2019 7:00 PM	MATLAB Code	445 KB
File_7.inp_res.m	10/29/2019 8:41 PM	MATLAB Code	445 KB
File_8.inp_res.m	10/29/2019 10:13 ...	MATLAB Code	445 KB
File_9.inp_res.m	10/29/2019 11:46 ...	MATLAB Code	445 KB
File_10.inp_res.m	10/30/2019 1:19 AM	MATLAB Code	445 KB
PROCESSING.m	2/24/2020 12:57 PM	MATLAB Code	1 KB
README	2/27/2020 11:29 AM	File	2 KB

Serpent output files

## Practical Exercises


### Uncertainty Propagation with CPSD

- Run '*PROCESSING.m*'
- Noise calculation with CORE SIM+
- A series of computation by batch process
- *Serpent output processing* + *CORE SIM+ input generation* + *neutron noise computation* (static solver & noise solver)
- Final results are saved in '*\RESULT\output\output*' folder

# Practical Exercises

## Uncertainty Propagation with CPSD

- Run *'PROCESSING.m'*
- Noise calculation with CORE SIM+
- A series of computation by batch process
- *Serpent output processing + CORE SIM+ input generation +*
- Final results are saved in *'\RESULT\output\output'* folder



Name	Date modified	Type	Size
dS_data_10.mat	3/10/2020 2:50 PM	MATLAB Data	32 KB
XS_data_10.mat	3/10/2020 2:49 PM	MATLAB Data	140 KB
dS_data_9.mat	3/10/2020 2:48 PM	MATLAB Data	32 KB
DYN_data_10.mat	3/10/2020 2:48 PM	MATLAB Data	1 KB
GEOM_data_10.mat	3/10/2020 2:48 PM	MATLAB Data	1 KB
XS_data_9.mat	3/10/2020 2:47 PM	MATLAB Data	140 KB
dS_data_8.mat	3/10/2020 2:46 PM	MATLAB Data	32 KB
DYN_data_9.mat	3/10/2020 2:46 PM	MATLAB Data	1 KB
GEOM_data_9.mat	3/10/2020 2:46 PM	MATLAB Data	1 KB
XS_data_8.mat	3/10/2020 2:45 PM	MATLAB Data	141 KB
DYN_data_8.mat	3/10/2020 2:44 PM	MATLAB Data	1 KB
GEOM_data_8.mat	3/10/2020 2:44 PM	MATLAB Data	1 KB
dS_data_7.mat	3/10/2020 2:44 PM	MATLAB Data	32 KB
XS_data_7.mat	3/10/2020 2:43 PM	MATLAB Data	140 KB
DYN_data_7.mat	3/10/2020 2:42 PM	MATLAB Data	1 KB
GEOM_data_7.mat	3/10/2020 2:42 PM	MATLAB Data	1 KB
dS_data_6.mat	3/10/2020 2:42 PM	MATLAB Data	32 KB
XS_data_6.mat	3/10/2020 2:40 PM	MATLAB Data	139 KB
dS_data_5.mat	3/10/2020 2:40 PM	MATLAB Data	31 KB
DYN_data_6.mat	3/10/2020 2:40 PM	MATLAB Data	1 KB
GEOM_data_6.mat	3/10/2020 2:40 PM	MATLAB Data	1 KB
XS_data_5.mat	3/10/2020 2:39 PM	MATLAB Data	141 KB
dS_data_4.mat	3/10/2020 2:38 PM	MATLAB Data	32 KB
DYN_data_5.mat	3/10/2020 2:38 PM	MATLAB Data	1 KB
GEOM_data_5.mat	3/10/2020 2:38 PM	MATLAB Data	1 KB
XS_data_4.mat	3/10/2020 2:37 PM	MATLAB Data	140 KB
DYN_data_4.mat	3/10/2020 2:36 PM	MATLAB Data	1 KB
GEOM_data_4.mat	3/10/2020 2:36 PM	MATLAB Data	1 KB
dS_data_3.mat	3/10/2020 2:36 PM	MATLAB Data	32 KB
XS_data_3.mat	3/10/2020 2:36 PM	MATLAB Data	140 KB
dS_data_2.mat	3/10/2020 2:35 PM	MATLAB Data	32 KB
DYN_data_3.mat	3/10/2020 2:35 PM	MATLAB Data	1 KB
GEOM_data_3.mat	3/10/2020 2:35 PM	MATLAB Data	1 KB
XS_data_2.mat	3/10/2020 2:34 PM	MATLAB Data	140 KB
dS_data_1.mat	3/10/2020 2:34 PM	MATLAB Data	32 KB
DYN_data_2.mat	3/10/2020 2:34 PM	MATLAB Data	1 KB
GEOM_data_2.mat	3/10/2020 2:34 PM	MATLAB Data	1 KB
XS_data_1.mat	3/10/2020 2:33 PM	MATLAB Data	141 KB
DYN_data_1.mat	3/10/2020 2:33 PM	MATLAB Data	1 KB
GEOM_data_1.mat	3/10/2020 2:33 PM	MATLAB Data	1 KB

# Practical Exercises

## Uncertainty Propagation with CPSD

- Run 'PROCESSING.m'
- Noise calculation with CORE SIM+
- A series of computation by batch process
- Serpent output processing + CORE SIM+ input generation + neutron noise computation (static solver & noise solver)
- Final results are saved in '\RESULT\output\output' folder

Name	Date modified	Type	Size
input	3/10/2020 3:01 PM	File folder	
output	3/10/2020 3:01 PM	File folder	
src	3/10/2020 2:58 PM	File folder	
CORESIMPplus.m	6/25/2019 1:20 PM	MATLAB Code	1 KB
CRIT_SOL_1.mat	3/10/2020 2:51 PM	MATLAB Data	1,764 KB
CRIT_SOL_2.mat	3/10/2020 2:52 PM	MATLAB Data	1,764 KB
CRIT_SOL_3.mat	3/10/2020 2:53 PM	MATLAB Data	1,763 KB
CRIT_SOL_4.mat	3/10/2020 2:53 PM	MATLAB Data	1,763 KB
CRIT_SOL_5.mat	3/10/2020 2:54 PM	MATLAB Data	1,763 KB
CRIT_SOL_6.mat	3/10/2020 2:55 PM	MATLAB Data	1,764 KB
CRIT_SOL_7.mat	3/10/2020 2:56 PM	MATLAB Data	1,764 KB
CRIT_SOL_8.mat	3/10/2020 2:57 PM	MATLAB Data	1,763 KB
CRIT_SOL_9.mat	3/10/2020 2:58 PM	MATLAB Data	1,764 KB
CRIT_SOL_10.mat	3/10/2020 2:58 PM	MATLAB Data	1,764 KB
RESULTS.mat	3/10/2020 2:58 PM	MATLAB Data	3,521 KB
RESULTS_1.mat	3/10/2020 2:51 PM	MATLAB Data	3,522 KB
RESULTS_2.mat	3/10/2020 2:52 PM	MATLAB Data	3,522 KB
RESULTS_3.mat	3/10/2020 2:53 PM	MATLAB Data	3,521 KB
RESULTS_4.mat	3/10/2020 2:53 PM	MATLAB Data	3,521 KB
RESULTS_5.mat	3/10/2020 2:54 PM	MATLAB Data	3,521 KB
RESULTS_6.mat	3/10/2020 2:55 PM	MATLAB Data	3,521 KB
RESULTS_7.mat	3/10/2020 2:56 PM	MATLAB Data	3,521 KB
RESULTS_8.mat	3/10/2020 2:57 PM	MATLAB Data	3,521 KB
RESULTS_9.mat	3/10/2020 2:58 PM	MATLAB Data	3,521 KB
RESULTS_10.mat	3/10/2020 2:58 PM	MATLAB Data	3,521 KB
SETTINGS.m	6/3/2019 1:17 PM	MATLAB Code	2 KB

Name	Date modified	Type	Size
RESULTS_1.mat	3/10/2020 2:59 PM	MATLAB Data	7,076 KB
RESULTS_2.mat	3/10/2020 2:59 PM	MATLAB Data	7,076 KB
RESULTS_3.mat	3/10/2020 2:59 PM	MATLAB Data	7,077 KB
RESULTS_4.mat	3/10/2020 2:59 PM	MATLAB Data	7,077 KB
RESULTS_5.mat	3/10/2020 3:00 PM	MATLAB Data	7,077 KB
RESULTS_6.mat	3/10/2020 3:00 PM	MATLAB Data	7,076 KB
RESULTS_7.mat	3/10/2020 3:00 PM	MATLAB Data	7,077 KB
RESULTS_8.mat	3/10/2020 3:00 PM	MATLAB Data	7,077 KB
RESULTS_9.mat	3/10/2020 3:01 PM	MATLAB Data	7,077 KB
RESULTS_10.mat	3/10/2020 3:01 PM	MATLAB Data	7,076 KB

## Practical Exercises

### Uncertainty Propagation with CPSD

- Run '*CPSD.m*'
  - Calculating CPSD at the detector location
  - Visualizing the output (amplitude and phase) range (not following Wilk's formula here, just min-max)

