

Test of roughness analysis software usage of the softgauges

2022 – 2024

1 Overview

A set of profiles with very different characteristics, mostly far beyond realistic measurements and partly being measurement data, are provided. The profiles for both the filtration and the roughness parameter estimators are either unrealistic artificial profiles to reveal numerical or algorithmic implementation issues or they are measured or synthetic but realistic profiles. Some profiles are artificial but a little bit closer to reality.

To ensure that the results of the laboratories that are to be compared are linked to identical tasks and profiles, a chain is created by referencing the MD5 checksum of the task file in the result and by referencing the MD5 checksum of the profile file in the task file. An MD5 checksum is a 128-bit hash value generated by the message-digest (MD) algorithm, a widely used hash function developed by Ronald Rivest in 1991. It is specified in the standard RFC 1321.

For each profile $n = 1, \dots$ at least one specifications file with a number $k = 1, 2, \dots$ is given, that defines the analysis task with all necessary input parameters facilitating the participating institutions or laboratories to process their tasks.

- For each test three zip archive files are assigned with following file names (the file extension name **sg** stands for softgauges):
 - `prf_n.sg` with the profile with the serial number n ,
 - `prf_n.specifications.k.sg` of the tasks,
 - `prf_n-<lab>_results.k.sg`.
- The three different types of files contain one json file each. For each type of json file exists a schema file accordingly
 - `v01.profile.schema.json`
 - `v01.specifications.schema.json`
 - `v01.results.schema.json`
- The profile `prf_n.sg` and for each profile one or more files specifying the task `prf_n.specifications.k.sg` are provided
- A file `prf_n-<lab>_results.k.sg` with the test results is to be generated by the participant, with an abbreviation of the participant's institution or company name.

2 Profiles

- The file `prf_n.sg` is a zip archive containing following files
 - `profile.json`
 - `profile.md5checksum.hex`
 - some may also contain a plot `prf_n.svg`
- The files should not be changed. The checksum can be used to check whether changes have been made to the `profile.json` file.
- The JSON object in `profile.json` contains the elements `HEADER` and `PROFILE`.
- The `HEADER` object contains general information such as the abbreviation of the participant's name, who generated the profile, a comment on which type of parameters are to be tested.
- The `PROFILE` object contains following elements
 - `n`: number n of sampling points of the profile
 - `dx`: distance Δx between the equidistant sampling points in Meter; such that to the length L of the profile applies: $L = n\Delta x$
 - `z`: array with the n ordinate values of the profile

3 Tasks – specifications

- The file `prf_n_specifications_k.sg` is a zip archive with
 - `specifications.json` with parameters for the evaluation task
 - `specifications.md5checksum.hex` MD5 checksum of the `specifications.json` file as a hexadecimal number
- The files shall not be changed. The checksum can be used to check whether changes have been made to the `specifications.json` file.
- The JSON object in `specifications.json` contains the elements `HEADER` and `SPECIFICATIONS`.
- The `HEADER` object contains an element called `profile`, which specifies the file name of the zip archive of the profile to which the specifications are assigned, and the checksum of the `profile.json` file.
- The `SPECIFICATIONS` object contains
 - alternative elements for the filtering task `NIS_FILTER` or `NIC_FILTER` or `NIF_FILTER`, here the “or” is an exclusive “or”.

It then includes one of the following properties (only one can occur within one specifications file):

- * `ISO_16610_21`
- * `ISO_16610_31`

and then includes following properties to specify the parameters of the filter

- * `closed` (if it the profile data refer to a closed profile, e.g. roundness, then the integer value 1 is given, otherwise it is an open profile indicated with value 0)
- * `store`
- * `nesting_index` (which in case of a linear filter as ISO 16610 21 is the same as the cut off wavelength)

if the element `NIS_FILTER` is used the resultant profile shall always be the low pass signal component; if the element `NIC_FILTER` is used the resultant profile can either be the low or high pass result, which is specified by the property

- * `transmission` (if the result shall be the low pass component, then the value is `S`, if it shall be the high pass component the value is `L`)
- or in case of the textue parameter tasks the specifications file always includes the element `EVALUATION_RANGE`, which is an a element array with start and end index of the evaluation length l_e .

It then includes following elements named according to the parameter sets defined in the clauses of the standard ISO 21920-2, of which all or any subset may occur within one specifications file:

- * `HEIGHT_PARAMETERS`
- * `SPATIAL_PARAMETERS` these have following properties
 - `s` the value of the ACF to define the correlation length X_{al}
 - `acf_estimator` specifies the algorithm to be used for the parameter X_{al} : if the convolution sum is to be used, then it has the value 0, if the Pearson (scalar product) algorithm is to be used, then it has the value 1
 - `xsw_optimizer_epsilon`
- * `HYBRID_PARAMETERS` these have following property
 - `slope_estimator`
 - has the value 0 if the gradient is to be evaluated by the coefficients of polynomials of degree 6 using six neighbouring data points and
 - the value 1 if the gradients are the first derivatives of the cubic splines interpolated to the profile
- * `MATERIAL_RATIO_FUNCTIONS`
- * `MATERIAL_RATIO_PARAMETERS` with elements `Xmr_p_percent_dc` and `Xdc_p_percent_q_percent`
- * `MATERIAL_RATIO_PARAMETERS_XK`
 - `mr_40_percent`
 - has the value 0 if the 40% interval is the interval of the secant of minimum slope
 - has the value 0 if the 40% interval is the interval of the regression line of minimum slope
- * `VOLUME_PARAMETERS`
- * `FEATURE_PARAMETERS_PEAK_PITS`
- * `FEATURE_PARAMETERS_PROFILE_ELEMENTS`

4 Results

- A zip archive named `prf_n_<lab>_results_k.sg` is to be created with the profile's serial number n , the task number k and the abbreviation of the name of the participating institution or laboratory containing
 - `results.json` with the values of all parameters according to the evaluation task, respectively the resultant profile if the task is a filtration task
 - `results_md5checksum.hex` MD5 checksum of the `results.json` file as a hexadecimal number
- The JSON object in `results.json` contains the objects `HEADER` and `RESULTS`

- The **HEADER** object contains the elements
 - **creator**, which specifies the file name of institution or laboratory that created the results,
 - **specifications**, which specifies two items: the file name of the zip archive of the specifications and the MD5 checksum of its **specifications.json** file,
 - optionally it can contain a comment string in **comment**.
- The **RESULTS** object contains either the parameter sets with the calculated values which are required by the specifications as elements if the task required roughness parameter calculations or it contains the element **NI...FILTER** if the task is filtration.
- All parameters contained in a parameter set must be delivered (or an empty array).
- For the element **MATERIAL_RATIO_FUNCTIONS**, the number of parameters corresponds to the number of parameters of the specifications (array elements).
- For invalid values the value for **DBL_MAX** (in C/C++) shall be entered.
- The parameters of dimension “length” must be given as the specified default in ISO 21920-3, if there is no specification in ISO 21920-3, they are to be given in Metre.
- All parameters must be specified in normalized scientific notation with 16 decimal places.