Study Committee B2

Overhead Lines

10975_2022

Structural reliability analysis of transmission line towers by use of advanced weather modelling

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Motivation

- Considerable part of grid at the end of design life
- Optimize lifetime extension costs with respect to decrease in failure rate

Objects

- Create tool to quantify the state of the assets and the failure probability.
- Obtain a better understand the "true" safety level inherent in existing design.

Method/Approach

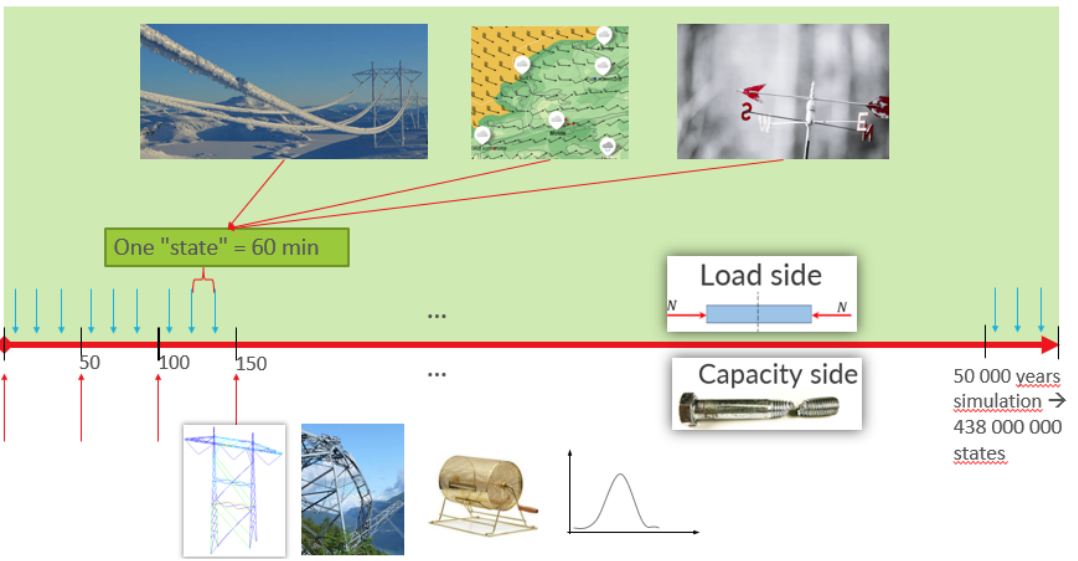
- Generate time series of weather from hindcast by Monte-Carlo simulation
- Stochastic capacities are generated by defining statistical distributions for all relevant design parameters.
- Obtain failure probability from simulating repeated design life cycles

Discussion

- By use of advanced copula functions, a superior correlation can be obtained, both between spatial points and between different parameters, i.e. temperature, wind speed and wind direction
- By generating realistic weather conditions for each transmission tower and line segment the accuracy is greatly improved compared to the pre-defined (a-priori) load cases presently used with the deterministic approach.
- Experience and measurements are important. Essential to compare results with real-world experience.

Conclusion

- Feasibility of using reliability analysis for power grids have been proved possible
- Results show good correlation between theory and practice
- Further use of tool is needed to build trust in the system



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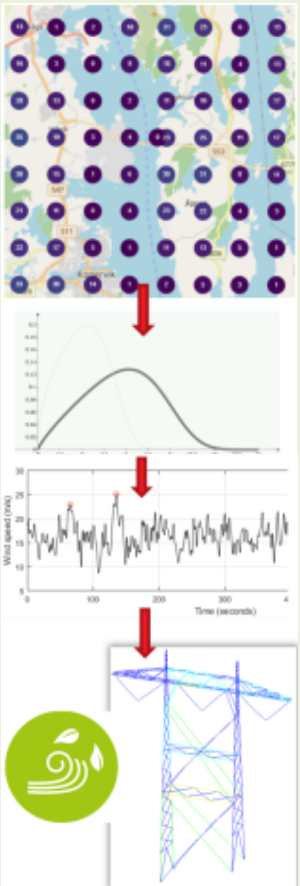
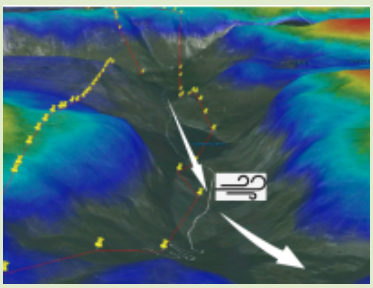
Challenges & opportunities

Capture complex behavior of icing

Simulate weather from hindcast



Local wind effects due to topology



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Assessing results

TowerID	Number of failures in simulation	Number of annual failures	Number of design life failures	Annual failure probability	Design life failure probability	Return period of annual failure
Trasé	10915	117	3	0.91	1.500	1
152-fm	42	20	3	0.16	1.50	6
153-bm	14	8	3	0.06	1.50	16
154-bm	14	6	3	0.05	1.50	21
155-bm	28	12	3	0.09	1.50	11
156-bm	18	11	3	0.09	1.50	12
157-bm	12	5	3	0.04	1.50	26
158-bmv	16	6	3	0.05	1.50	21
159-bm	8	3	2	0.02	1.00	43
160-bm	16	6	3	0.05	1.50	21
161-bm	9	6	3	0.05	1.50	21
162-bm	10	4	3	0.03	1.50	32
163-fm	0	0	0			
164-bm	3228	29	2	0.23	1.00	4
165-bm	297	48	3	0.38	1.50	3
166-bm	637	57	3	0.45	1.50	2
167-bm	1223	66	3	0.52	1.50	2
168-bm	1765	72	3	0.56	1.50	2
169-bm	2826	79	3	0.62	1.50	2
170-bmv	3297	90	3	0.70	1.50	1
171-fm	2943	92	3	0.72	1.50	1
172-bm	5629	53	3	0.41	1.50	2
173-bm	442	27	3	0.21	1.50	5
174-bmv	384	36	3	0.28	1.50	4
175-fm	2907	97	3	0.76	1.50	1
176-bm	843	59	3	0.46	1.50	2
177-bm	154	42	3	0.33	1.50	3
178-bm	0	0	0			
179-bm	0	0	0			
180-fm	6	5	3	0.04	1.50	26
181-fm	1	1	1	0.01	1	128