

DIN EN 16603-60-10:2014-12 (E)

Space engineering - Control performances; English version EN 16603-60-10:2014

Contents	Page
Foreword	5
Introduction	6
1 Scope	7
2 Normative references	8
3 Terms, definitions and abbreviated terms	9
3.1 Terms from other standards.....	9
3.2 Terms specific to the present standard	9
3.3 Abbreviated terms.....	14
4 Performance requirements and budgeting	15
4.1 Specifying a performance requirement	15
4.1.1 Overview	15
4.1.2 Elements of a performance requirement	16
4.1.3 Elements of a knowledge requirement	16
4.1.4 Probabilities and statistical interpretations.....	17
4.2 Use of error budgeting to assess compliance	17
4.2.1 Scope and limitations	17
4.2.2 Identification and characterisation of contributors.....	18
4.2.3 Combination of contributors	19
4.2.4 Comparison with requirement	21
5 Stability and robustness specification and verification for linear systems	23
5.1 Overview	23
5.2 Stability and robustness specification	24
5.2.1 Uncertainty domains	24
5.2.2 Stability requirement	26
5.2.3 Identification of checkpoints	26
5.2.4 Selection and justification of stability margin indicators	27
5.2.5 Stability margins requirements	27
5.2.6 Verification of stability margins with a single uncertainty domain.....	28

5.2.7	Verification of stability margins with reduced and extended uncertainty domains	28
Annex A (informative) Use of performance error indices		29
A.1	Formulating error requirements.....	29
A.1.1	More about error indices	29
A.1.2	Statistical interpretation of requirements	30
A.1.3	Knowledge requirements.....	32
A.1.4	Specifying the timescales for requirements	32
A.2	More about performance error budgets.....	34
A.2.1	When to use an error budget.....	34
A.2.2	Identifying and quantifying the contributing errors	35
A.2.3	Combining the errors.....	36
A.2.4	Comparison with requirements.....	38
Annex B (informative) Inputs to an error budget.....		40
B.1	Overview	40
B.2	Bias errors	41
B.3	Random errors.....	42
B.4	Periodic errors (short period)	44
B.5	Periodic errors (long period)	44
B.6	Distributions of ensemble parameters.....	45
B.7	Using the mixed statistical distribution	48
Annex C (informative) Worked example		49
C.1	Scenario and requirements.....	49
C.2	Assessing the contributing errors.....	50
C.3	Compiling the pointing budgets.....	52
Annex D (informative) Correspondence with the pointing error handbook		54
References		55
Bibliography.....		56
 Figures		
Figure A-1 : Example showing the APE, MPE and RPE error indices.....		30
Figure A-2 : Example showing the PDE and PRE error indices		30
Figure A-3 : Example of a statistical ensemble of errors.....		31
Figure A-4 : The different ways in which a requirement for $P(\varepsilon < 1^\circ) > 0,9$ can be met		32
Figure A-5 : Illustration of how the statistics of the pointing errors differ depending on which statistical interpretation is used		32

Figure C-1 : Scenario example	50
-------------------------------------	----

Tables

Table B-1 : Parameters whose distributions are assessed for the different pointing error indices (knowledge error indices are similar)	41
Table B-2 : Budget contributions from bias errors, where B represents the bias	42
Table B-3 : Budget contributions from zero mean Gaussian random errors	43
Table B-4 : Uniform Random Errors (range 0-C)	43
Table B-5 : Budget contributions for periodic errors (low period sinusoidal)	44
Table B-6 : Budget contributions for periodic errors (long period sinusoidal)	45
Table B-7 : Some common distributions of ensemble parameters and their properties	47
Table C-1 : Example of contributing errors, and their relevant properties	51
Table C-2 : Example of distribution of the ensemble parameters	52
Table C-3 : Example of pointing budget for the APE index	53
Table C-4 : Example of pointing budget for the RPE index	53
Table D-1 : Correspondence between Pointing error handbook and ECSS-E-ST-60-10 indicators	54