BioRID II Repeatability & Reproducibility – TRL Baseline Tests

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Shape Correlation

- Estimate of the similarity, in shape, between two (2) signals
- Shape (cross) correlation at shift “m”

$$S_{xy}(m) = \frac{\sum x_i \times y_{i+m}}{\sqrt{\sum x_i^2 \times \sum y_i^2}}$$

- Shape correlation

$$S = S_{xy}(m_o) = \max_m S_{xy}(m)$$

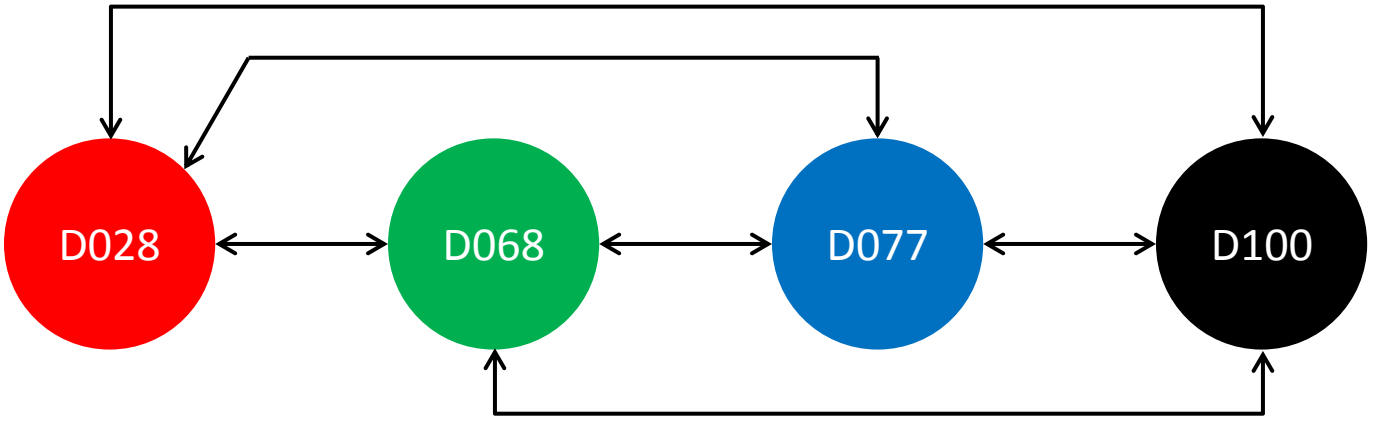
Shape Correlation – Repeatability

- Cross correlation of signals within the repeats of the same dummy
- We have five (5) repeats per dummy, thus ten (10) cross correlations for each dummy

		Test #					Number of Analysis
		1	2	3	4	5	
Test #	1		✓	✓	✓	✓	4
	2			✓	✓	✓	3
	3				✓	✓	2
	4					✓	1
	5						Total: (5x4)/2 = 10

Shape Correlation – Reproducibility

- Twenty five (25) cross correlations for each set of two (2) dummies
- We have four (4) dummies thus six (6) combinations for a total of one hundred fifty (150) cross correlations



Magnitude

p−norm $\|\mathrm{x}\|_p = \left(\sum |x_i|^p\right)^{\frac{1}{p}}$

Taxicab $\|\mathrm{x}\|_1 = \sum |x_i|$

Euclidian $\|\mathrm{x}\|_2 = \sqrt{\sum x_i^2}$

Infinity $\|\mathrm{x}\|_\infty = \max\{|x_1|, \ldots, |x_n|\}$

Magnitude Coefficient of Variation

- For each of the magnitude measures, we compute the coefficient of variation

$$\mathrm{CV}_{\mathrm{Taxicab}} = {}^{\sigma_{\mathrm{Taxicab}}}\!/_{\mu_{\mathrm{Taxicab}}}$$

$$\mathrm{CV}_{\mathrm{Euclidian}} = {}^{\sigma_{\mathrm{Euclidian}}}\!/_{\mu_{\mathrm{Euclidian}}}$$

$$\mathrm{CV}_{\mathrm{Infinity}} = {}^{\sigma_{\mathrm{Infinity}}}\!\Big/_{\mu_{\mathrm{Infinity}}}$$

- The above values are computed for the twenty (20) signals distribution
- Note that $\mathrm{CV}_{\mathrm{Infinity}}$ is the commonly reported CV

Analyzed Channels

Test No.			8	10	11	14	20	7	9	12	13	19	2	3	6	16	17	1	4	5	15	18	Overall	Number
			M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		
			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
			1	2	2	2	2	1	2	2	2	2	1	1	1	2	2	1	1	1	2	2		
			1	0	0	0	0	1	0	0	0	0	1	1	1	0	0	1	1	1	0	0		
			2	1	1	1	1	2	1	1	1	1	2	2	2	1	1	2	2	2	1	1		
			2	0	1	1	1	2	0	1	1	1	1	2	2	1	1	1	2	2	1	1		
			3	9	0	1	3	2	9	0	1	3	9	0	1	2	2	6	0	1	1	2		
			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
			1	7	2	2	3	1	2	3	1	1	1	1	2	1	2	1	4	1	3	3	Number	of
Dummy No.			D028	D028	D028	D028	D028	D068	D068	D068	D068	D068	D077	D077	D077	D077	D077	D100	D100	D100	D100	D100	of Tests	Dummies
Head		Ax	8	8	8	8	8	9	9	9	9	9	9	9	9	9	9	8	8	8	8	8	20	4
		Az	9	7	7	7	7	8	8	8	8	8	28	28	28	7	8	9	9	9	9	9	20	4
Neck	Upper	Fx	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	11	11	11	11	11	20	4
		Fz	11	11	11	11	11	11	11	11	11	11	12	12	12	12	12	12	12	12	12	12	20	4
		My	12	12	12	12	12	12	12	12	12	12	13	13	14	14	14	13	13	13	13	13	20	4
		C4 Ax	14	14	13	13	13	13	13	13	13	13	16	16	16	16	16	16	16	16	16	16	20	4
		C4 Az	13	13	14	14	14	14	14	14	14	14	17	17	17	17	17	17	17	17	17	17	20	4
	Lower	Fz	18	18	18	18	18	19	19	19	19	19	23	23	23	23	23	22	22	22	22	22	20	4
		My	19	19	19	19	19	20	20	20	20	20	24	24	24	24	24	23	23	23	23	23	20	4
Thorax		T1 Ax	15	15	15	15	15	16	15	15	15	15	19	19	19	19	19	18	18	18	18	18	20	4
		T1 Az						15	16	16	16	16	20	20	20	20	20	19	19	19	19	19	15	3
		T8 Ax	20	20	20	20	20	21	21	21	21	21	25	25	25	25	25	24	24	24	24	24	20	4
		T8 Az						22	22	22	22	22	26	26	26	26	26	25	25	25	25	25	15	3
Lumbar		L1 Ax	21	21	21	21	21	23	23	23	23	23	27	27	27	27	27	32	32	32	32	32	20	4
		L1 Az	22	22	22	22	22	24	24	24	24	24	8	8	8	28	28	33	33	33	33	33	20	4
Pelvis		Ax	25	23	23	23	24	25	25	25	25	25	31	31	31	31	31	34	34	34	34	34	20	4
		Az	23	25	25	25	23	27	27	27	27	27	30	30	30	30	30	36	36	36	36	36	20	4
Total Number of Channels			15	15	15	15	15	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17		

Results Summary

			Shape		Magnitude CVs - Reproducibility			Overall Score
			Repeatabilty	Reproducibility	Taxicab	Euclidian	Infinity	
Head		Ax	Good	Good	Acceptable	Acceptable	Marginal	4
		Az	Good	Marginal	Marginal	Poor	Poor	10
Neck	Upper	Fx	Good	Good	Marginal	Acceptable	Poor	6
		Fz	Good	Good	Marginal	Poor	Poor	8
		My	Good	Marginal	Poor	Poor	Poor	11
		C4 Ax	Good	Good	Acceptable	Marginal	Poor	6
		C4 Az	Good	Acceptable	Marginal	Marginal	Marginal	7
	Lower	Fz	Acceptable	Marginal	Marginal	Marginal	Poor	10
		My	Good	Acceptable	Marginal	Marginal	Poor	8
Thorax		T1 Ax	Good	Good	Good	Acceptable	Poor	4
		T1 Az	Good	Poor	Marginal	Poor	Poor	11
		T8 Ax	Good	Good	Good	Good	Marginal	2
		T8 Az	Acceptable	Poor	Marginal	Marginal	Poor	11
Lumbar		L1 Ax	Good	Good	Good	Good	Marginal	2
		L1 Az	Good	Acceptable	Marginal	Marginal	Poor	8
Pelvis		Ax	Good	Good	Acceptable	Marginal	Poor	6
		Az	Good	Marginal	Poor	Poor	Poor	11
Counts	Good	>= 97.5 %	15	8	3	2	0	
	Acceptable	>= 95.0 %	2	3	3	3	0	
	Marginal	>= 90.0 %	0	4	9	7	4	
	Poor	< 90.0 %	0	2	2	5	13	