SigmML: Metric meta-learning for Writer Independent Offline Signature Verification in the Space of SPD Matrices (Supplementary Material)

Alexios Giazitzis and Elias N. Zois
Telsip Laboratory, UniWA
Petrou Ralli & Thivon Ave., 12241, Egaleo, Greece
{ene262017050, ezois}@uniwa.gr

1. Covariance matrix computation

Let us denote with P the number of signature trace pixels in I. The image covariance matrix $\mathbf{C}$ of d image features $F(I)$ is computed by Eq. (1):

$$\mathbf{C} = \frac{1}{\mathrm{P}-1} \sum_{i=1}^{\mathrm{P}} \left(f_i - \overline{f}\right)^{\mathrm{T}} \left(f_i - \overline{f}\right) \in \mathcal{S}_d^+ \qquad (1)$$

where f_i corresponds to the i-th pixels's d-dimensional vector of features, $\overline{f}$ corresponds to their mean vector and $\mathcal{S}_d^+$ refers to the corresponding d-dimensional SPD manifold. We address the infrequent situation, that $\mathbf{C}$ is not strictly positive definite, by adding to $\mathbf{C}$ a small regularization term $\lambda \mathbf{I}_{10 \times 10}$, where $\mathbf{I}_{10 \times 10}$ is the identity matrix and $\lambda = 10^{-5}$, *i.e.* $\mathbf{C}_{new} = \mathbf{C}_{old} + \lambda \times \mathbf{I}_{10 \times 10}$. Thus we continue by asserting that all signature covariance matrices are points in the $\mathcal{S}_{10}^+$ manifold.

2. The optimization hyperparameters values

Hyperparameter	Value
Observation Epochs	600
Optimizer Learning Epochs	200
Optimizer Learning Rate	0.001
Handcrafted Optimizer Learning Rate	0.01
Learner Epochs	50
Data batch size	512
mLSTM layers	2
Optimization steps τ	205
Reset Steps T	5
Optimizer batch size m	12
Similarity threshold ζ_s	0.01
Dissimilarity threshold ζ_d	1

Table 1. Hyperparameter values for the learning process.