5.6. Complexity Analysis

This subsection discuss the computational complexity of the proposed framework,

focusing on the main steps, which are the eigenvalues decomposition (EVD),

largest eigenvalues analysis, application of MOS scheme and eigen similarity

680 analysis, according to Figure 7 and equations presented in Section 4.

The EVD, calculated according to (6), requires the previous calculation of

covariance matrix, according to Equations 2, 3, 4 and 5. The covariance matrix

calculation is O(M2N) and the EVD is O(N3), where M denotes the number

of network ports and N denotes the period time. Therefore, the computational

685 complexity for all steps for EVD can be represented as O(M2N+N3) and yields

an O(N3) upper bound on the worst-case running time for EVD.

EDC and EFT are the MOS schemes that presented accuracy on the evaluation

for the network attack detection. The computational complexity evaluation for MOS focuses on EDC scheme, since EDC requires less processing time than

690 EFT, but presents the same accuracy for the evaluated scenario. EDC scheme is

O(QlogQ + Q + QlogQ) and its worst-case running time can be represented as

O(QlogQ), where Q denotes the number of time frames.

The largest eigenvalue analysis is O( ^ dQ), where ^ d denotes the number of time

frame under attack, according to Algorithm 1. Subsequently, the eigen similarity

695 analysis relies on EVD and cosine similarity analysis, which is O(N2), for d^time

frames, therefore the eigen similarity analysis is which is O( ^ d(M2N +N3+N2))

and yields an O(N3) upper bound on the worst-case running time for eigen

similarity analysis.

Therefore, the proposed framework is O(N3 + QlogQ + ^ dQ + N3) and its

700 worst-case running time is O(N3). The computational complexity of EVD is

predominant in the framework, but the approach splits the data into time frames

with period time N, which makes possible to limitate the growth of N even for

evaluations of cases with total time larger than N, reducing the impact caused

by the computational complexity of EVD.