

## Response to Reviewer

We thank the reviewer for the careful reading of the manuscript and for the positive assessment of the revisions. We appreciate the constructive comments, which helped us further improve the clarity of the paper. All suggested modifications have been addressed as detailed below.

### Comment 1

Overall, section 2.2.7 "Combined objective and training schedule" and 2.6 "Optimization and training schedule" have redundant information. Section 2.6 repeats all the training steps, notations and justifications that were already introduced in 2.2.7 (line 314-328 in 2.2.7 and line 378-395 in 2.6). The information is valuable and should be kept. However, section 2.6 can maybe be either reworked to avoid repetition with 2.2.7, or removed. For the latter, information that is exclusively in 2.6 (line 373-377, line 396-398, gradient reversal scale...) could move back to the "implementation details" section.

### Response

We thank the reviewer for pointing out this redundancy. We agree that Sections 2.2.7 and 2.6 contained overlapping descriptions of the staged training procedure. To improve clarity and avoid repetition, we retained Section 2.2.7 as the main methodological description of the combined objective and staged training strategy, and we shortened Section 2.6 so that it now contains only implementation-specific optimization details.

Specifically, the revised Section 2.6 is limited to the optimizer and scheduler settings, batch size, gradient clipping, early stopping, the gradient-reversal scale, DEC centroid initialization, and the maximum training duration. The repeated description of the staged activation of the reconstruction, domain-adversarial, and DEC objectives, together with its rationale, has been removed from Section 2.6 and kept in Section 2.2.7. This preserves the relevant information while eliminating the redundancy between the two sections.

### ***Before***

Section 2.6 repeated the staged training schedule already introduced in Section 2.2.7, including the sequential activation of the reconstruction, domain-adversarial, and

DEC objectives, as well as the explanation of why this ordering improves stability and interpretability.

### ***After***

Section 2.6 now contains only implementation-specific optimization details:

- Adam optimizer and learning-rate scheduler
- batch size, gradient clipping, and early stopping
- gradient-reversal scale  $\gamma = 0.4$
- DEC centroid initialization with  $k$ -means and  $n_{\text{clusters}} = 5$
- maximum training duration and reference to the loss-evolution results.

### Comment 2

Line 328: "The resulting training dynamics are discussed in Section 3.2". Is it 3.2 or 3.1?

### Response

Thank you for this comment, We intended to refer to Section 3.1, and this has been corrected in the revised manuscript.

Before :

The resulting training dynamics are discussed in Section 3.2.

After :

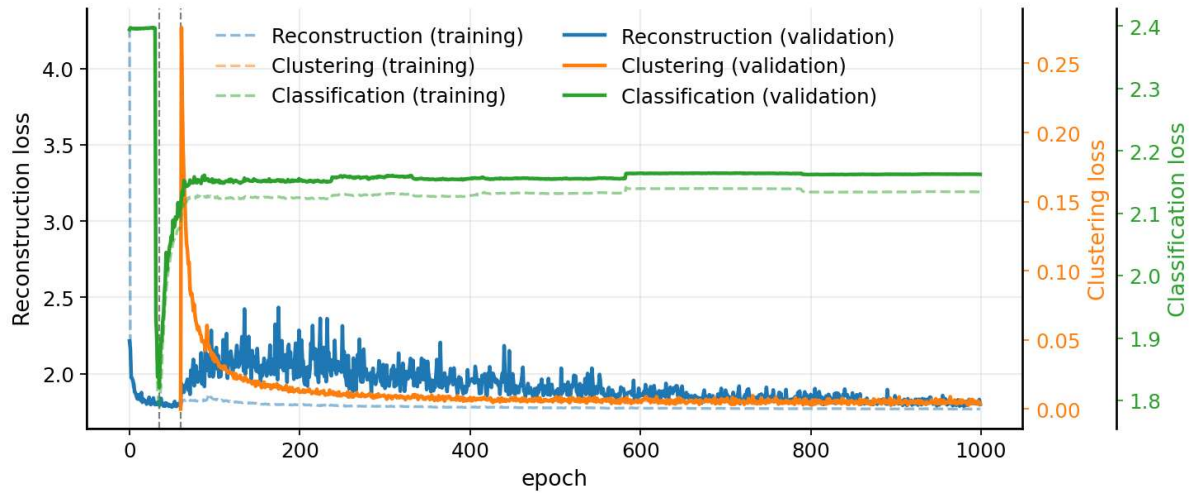
The resulting training dynamics are discussed in Section 3.1

### Comment 3

Figure 3: it is not so easy to distinguish between training and validation losses (especially for reconstruction error). Consider using a different line style (like dashes) or different shades of the same color.

### Response

We agree that the distinction between the training and validation curves could be improved. In response, we updated Figure 3 to make the validation losses clearly distinguishable by using solid lines for validation curves and dashed lines for training curves. Additionally, we adjust the different transparency level so that the different is more obvious and to put the focus on the validation.



We thank the reviewer again for the helpful comments, which helped improve the clarity and presentation of the manuscript..