De: **Transactions on Pattern Analysis and Machine Intelligence** onbehalfof@manuscriptcentral.com
Objet: Decision & Thank You - TPAMI-2020-03-0293.R1
Date: 10 décembre 2020 à 15:50
À: sven@cs.toronto.edu

RE: TPAMI-2020-03-0293.R1, "Linear and Deep Order-Preserving Wasserstein Discriminant Analysis"
Manuscript Type: Regular

Dear Reviewer,

Thank you for participating in the review process of the above referenced manuscript.

The Associate Editor, Dr. Zhuowen Tu, has submitted the following recommendation to the Editor-in-Chief: Minor Revisions Required. Below are the sanitized reviews. (If the decision is MAJOR REVISION, you will be asked to act as a reviewer again.)

Please let us know if you have any questions. Thank you for your participation with TPAMI's review process. Your participation is an invaluable service to the IEEE Computer Society.

Thank you,

Mrs. Joyce Arnold
Administrator
IEEE Transactions on Pattern Analysis and Machine Intelligence
jarnold@computer.org

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Editor Comments

Associate Editor
Comments to the Author:
There is a consensus that this revision has a large improvement over the original manuscript.
One reviewer still has reservations regarding the novelty of the paper, which should be further highlighted. There are other issues that can be addressed by including experiments for an end-to-end alternative and improving the writing of the introduction section for a clearer motivation.

The authors are encouraged to revise the paper by following reviewers' comments.

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Reviewer Comments

Reviewer: 1

Recommendation: Accept With No Changes

Comments:
The authors have a really excellent job in producing the revisions requested by the reviewers. They have addressed all of my concerns thorough additional explanations and experiments, for which I thank them. I believe that the paper is ready for publication.

The only negative is that the proposed method are the results on the NTU dataset which are a little underwhelming. However, there is enough novelty and additional empirical studies over the conference paper to make the current version suitable for acceptance.

Additional Questions:
1. Which category describes this manuscript?: Research/Technology

2. How relevant is this manuscript to the readers of this periodical? If you answer Not very relevant or Irrelevant please explain your rating under Public Comments below.: Very Relevant

1. Please evaluate the significance of the manuscript’s research contribution.: Good

2. Please explain how this manuscript advances this field of research and/or contributes something new to the literature.: The manuscript is an extension of a previously published conference paper.

Taken together, the authors describe a novel projection discriminative projection framework under the order-preserving wasserstein metric. They also discuss implementation issues and conduct experiments clearly showing the value of the proposed scheme for sequence classification.

The authors extend the ideas in the conference paper significantly. In particular, they describe learning non-linear features with neural networks so as maximize OWDA distance. This deep learning extension further boosts classification performance on standard skeletal action recognition datasets over the linear OWDA.

3. Is the manuscript technically sound? In the Public Comments section, please provide detailed explanations to support your assessment: Yes

1. Are the title, abstract, and keywords appropriate? If not, please comment in the Public Comments section.: Yes

4. How thorough is the experimental validation (where appropriate)? Please discuss any shortcomings in the Public Comments section.: Lacking in some respects; some cases of interest not tested

2. Does the manuscript contain sufficient and appropriate references? Please comment and include additional suggested references in the Public Comments section.: References are sufficient and appropriate

3. Does the introduction state the objectives of the manuscript in terms that encourage the reader to read on? If not, please explain your answer in the Public Comments section.: Yes

4. How would you rate the organization of the manuscript? Is it focused? Please elaborate with suggestions for reorganization in the Public Comments section.: Satisfactory

6. How is the length of the manuscript? If changes are suggested, please make explicit recommendations in the Public Comments section.: About right

5. Please rate the readability of the manuscript. Explain your rating under Public Comments below.: Readable - but requires some effort to understand

7. Should the supplemental material be included? (Click on the Supplementary Files icon to view files): Yes, as part of the digital library for this submission if accepted

8. If yes to 7, should it be accepted: As is

Please rate the manuscript overall. Explain your choice.: Good

Reviewer: 2

Recommendation: Reject

Comments:
In the previous round of review, I recommended to reject this paper since it relies on an already published paper (OWDA) and the novelty for this paper is in DeepOWDA.
I pointed out that this deep variant was questionnable since it relies on a transport in the original space as a proxy to the transport in the latent space.
As acknowledged by the authors in the rebuttal and in the updated version of the paper (I admit that the added text makes it much clearer and the paper is definitely improved with this respect), this is done to keep the method computationally tractable and is purely heuristic.
"Therefore, the optimal transports in the subspace may not change too much from those in the original space."
-> I see no validation for this heuristic in the paper.
"In addition, since the transport matrices build the optimal correspondences between features in the original sequences under the OPW distance, discriminating sequences according to such correspondences is also likely to lead to better separability between different sequence classes, even if the optimal transports change in the subspace."
-> I agree with this, but I still think that with this in mind, the novel contribution of this paper is rather limited.

The fact that an alternating optimizing scheme is not more satisfactory is not sufficient to motivate the approach, and I see no proof in the updated version that transports in original and latent space match.

So I will tend to stick to my initial rating that the novel parts of this paper are not sufficient for an IEEE TPAMI paper.

Regarding the missing references, I acknowledge that the authors have referenced these works properly and considered them as baselines in their experiments, which is notable.
I also acknowledge that authors have answered my other concerns.

Additional Questions:
1. Which category describes this manuscript?: Research/Technology

2. How relevant is this manuscript to the readers of this periodical? If you answer Not very relevant or Irrelevant please explain your rating under Public Comments below.: Very Relevant

1. Please evaluate the significance of the manuscript's research contribution.: Fair - Even with the recommended changes, the contribution of this paper is unlikely be significant enough for publication in TPAMI.

2. Please explain how this manuscript advances this field of research and/or contributes something new to the literature.: This paper introduces a dimensionality reduction technique for sequences.
The method, called OWDA (a deep variant is also introduced, see below) learns a linear mapping (in a Linear Discriminant Analysis fashion) such that once features are mapped to this space, the Order Preserving Wasserstein distance best discriminates between classes.

This method was presented in an ICCV 2019 paper, and the main improvements offered by this version are:
- a deep variant that no longer learns a linear mapping but a mapping that is parametrized by a deep network
- experiments on a larger human activity recognition dataset (NTU)
- new baselines including CTW and variants

These definitely represent some added value, yet whether this added value is sufficient for a IEEE TPAMI publication is highly questionable, especially given some strong limitation of the introduced deep variant (see below).

3. Is the manuscript technically sound? In the Public Comments section, please provide detailed explanations to support your assessment: Yes

1. Are the title, abstract, and keywords appropriate? If not, please comment in the Public Comments section.: Yes

4. How thorough is the experimental validation (where appropriate)? Please discuss any shortcomings in the Public Comments section.: Compelling experiments; clearly state of the art

2. Does the manuscript contain sufficient and appropriate references? Please comment and include additional suggested references in the Public Comments section.: References are sufficient and appropriate

3. Does the introduction state the objectives of the manuscript in terms that encourage the reader to read on? If not, please explain your answer in the Public Comments section.: Yes

4. How would you rate the organization of the manuscript? Is it focused? Please elaborate with suggestions for reorganization in the Public Comments section.: Satisfactory

6. How is the length of the manuscript? If changes are suggested, please make explicit recommendations in the Public Comments section.: About right

5. Please rate the readability of the manuscript. Explain your rating under Public Comments below.: Easy to read

7. Should the supplemental material be included? (Click on the Supplementary Files icon to view files): Yes, as part of the digital library for this submission if accepted

8. If yes to 7, should it be accepted: As is

Please rate the manuscript overall. Explain your choice.: Fair

Reviewer: 3

Recommendation: Accept With No Changes

Comments:
I think the main idea of the paper is very good. Novelty of the paper is sufficient for publication.

Introduction can be improved. Still the motivation of the methods is not very convincing.

Even if the same action could have somewhat similar evolution, some actions might have large variations in execution. If there are large variations within a class, the algorithm in section 3.2 can fail.

The main idea of the paper is to use the Fisher criterion to maximize the separability,
i.e., to maximize the ratio of the inter-sequence class distance to the intra-sequence-class dispersion. I think it would have been easier for the reader if paper starts with this main idea and then explains the algorithm.

Experiments are okay.

I just wonder how this method will perform against purely neural based methods such as Transformer Encoders?

Overall, this is a very good paper.

Additional Questions:
1. Which category describes this manuscript?: Research/Technology

2. How relevant is this manuscript to the readers of this periodical? If you answer Not very relevant or Irrelevant please explain your rating under Public Comments below.: Very Relevant

1. Please evaluate the significance of the manuscript's research contribution.: Good

2. Please explain how this manuscript advances this field of research and/or contributes something new to the literature.: This paper presents an interesting subspace method for sequence data. Main idea is to represent order-preservingWasserstein-based separability measures among sequence classes. The idea of using sequence prototypes for each class using Order-preserving Wasserstein barycenter for action classification is useful. For a set of sequences, the barycenter serves as the "mean" sequence

Wasserstein barycenter for action classification is useful. For a set of sequences, the barycenter serves as the "mean" sequence and reflects the average evolution. Paper also explores a method by considering the within class scatter.

3. Is the manuscript technically sound? In the Public Comments section, please provide detailed explanations to support your assessment: Yes

1. Are the title, abstract, and keywords appropriate? If not, please comment in the Public Comments section.: Yes

4. How thorough is the experimental validation (where appropriate)? Please discuss any shortcomings in the Public Comments section.: Compelling experiments; clearly state of the art

2. Does the manuscript contain sufficient and appropriate references? Please comment and include additional suggested references in the Public Comments section.: References are sufficient and appropriate

3. Does the introduction state the objectives of the manuscript in terms that encourage the reader to read on? If not, please explain your answer in the Public Comments section.: Could be improved

4. How would you rate the organization of the manuscript? Is it focused? Please elaborate with suggestions for reorganization in the Public Comments section.: Satisfactory

6. How is the length of the manuscript? If changes are suggested, please make explicit recommendations in the Public Comments section.: About right

5. Please rate the readability of the manuscript. Explain your rating under Public Comments below.: Easy to read

7. Should the supplemental material be included? (Click on the Supplementary Files icon to view files): Yes, as part of the digital library for this submission if accepted

8. If yes to 7, should it be accepted: As is

Please rate the manuscript overall. Explain your choice.: Good

Reviewer: 4

Recommendation: Author Should Prepare A Minor Revision

Comments:
I have checked the revised version of the manuscript as well as the comments provided by the Fellow Reviewers. I am thankful to the authors for the effort they provided in addressing the changes: as, a result, the paper improved substantially.

However, there is still a last aspect, which was highlighted from the first reviewing stage and still left partially unaddressed by the authors: the fact that, by means of an end-to-end learning approach, they could manage to boost the performance of their method and close the gap with respect to the state-of-the-art. I am not fully convinced of what authors claim in Section 5.5 of the revised version of the paper (e.g., "...our goal is not to achieve state-of-the-art results on this specific dataset") - since this is partially contradicting what is stated in the abstract ("Experiments show that OWDA and DeepOWDA achieve competitive results on four 3D action recognition datasets"). I would really encourage the authors to report experiments on an end-to-end variant of the method, given that this seems a viable variant after what authors respond in their list of changes.

Additional Questions:
1. Which category describes this manuscript?: Research/Technology

2. How relevant is this manuscript to the readers of this periodical? If you answer Not very relevant or Irrelevant please explain your rating under Public Comments below.: Very Relevant

1. Please evaluate the significance of the manuscript's research contribution.: Good

2. Please explain how this manuscript advances this field of research and/or contributes something new to the literature.: New method for human action recognition.

3. Is the manuscript technically sound? In the Public Comments section, please provide detailed explanations to support your assessment: Yes

1. Are the title, abstract, and keywords appropriate? If not, please comment in the Public Comments section.: Yes

4. How thorough is the experimental validation (where appropriate)? Please discuss any shortcomings in the Public Comments section.: Lacking in some respects; some cases of interest not tested

2. Does the manuscript contain sufficient and appropriate references? Please comment and include additional suggested references in the Public Comments section.: References are sufficient and appropriate

3. Does the introduction state the objectives of the manuscript in terms that encourage the reader to read on? If not, please explain your answer in the Public Comments section.: Yes

4. How would you rate the organization of the manuscript? Is it focused? Please elaborate with suggestions for reorganization in the Public Comments section.: Satisfactory

6. How is the length of the manuscript? If changes are suggested, please make explicit recommendations in the Public Comments section.: About right

5. Please rate the readability of the manuscript. Explain your rating under Public Comments below.: Readable - but requires some effort to understand

7. Should the supplemental material be included? (Click on the Supplementary Files icon to view files): Yes, as part of the digital library for this submission if accepted

8. If yes to 7, should it be accepted: As is

Please rate the manuscript overall. Explain your choice.: Good