

# Robust Latent Low Rank Representation for Subspace Clustering

Hongyang Zhang, Zhouchen Lin, *Senior Member, IEEE*, Chao Zhang, *Member, IEEE*, Junbin Gao

## I. INTRODUCTION

In the latest study, researchers analysed lung and adrenal-gland tissue samples from 46 dolphins that were found dead in Louisiana, Mississippi and Alabama areas that experienced significantly elevated levels of petroleum compounds.

ABC  
BCD  
CDE

This is a sentence. A dog is good.  
A dog is good.  
This is a sentence. An dog is good.  
An dog is good.  
An European is good.  
An one is good.  
An uniform is good.  
An union is good.  
An unique man is good.  
An unit is good.  
An university is good.  
An user is good.  
A honest man is good.  
A honor is good.  
A hour is good.  
A A is good.  
A E is good.  
A F is good.  
A H is good.

I like A, B.  
I like apple, banana.  
I like Amy, Bob.  
I like Google, Apple.  
I like A and B.  
I like apple and banana.  
I like Amy and Bob.  
I like Google and Apple.  
I like A, B, and C.  
I like apple, banana, and totato.  
I like Amy, Bob, and Cherry.  
I like Google, Apple, and Microsoft.

I like A, B and C.  
I like apple, banana and totato.  
I like Amy, Bob and Cherry.  
I like Google, Apple and Microsoft.

A, B, and C, etc.  
apple, banana, and totato, etc.  
Amy, Bob, and Cherry, etc.  
Google, Apple, and Microsoft, etc.  
A, B, C, etc.  
apple, banana, totato, etc.  
Amy, Bob, Cherry, etc.  
Google, Apple, Microsoft, etc.

Because he didn't have much money in college and it wasn't just handed to him.  
Well, the mainstream press didn't give us the inside story, so we have to keep asking on Quora.  
I don't romanticize Elon Musk as a guy.  
Well, just because the general population isn't as fascinated with him as they are with Jobs or Zukerberg doesn't mean some people aren't.  
Honestly, I don't get it.

## II. ROBUST LATENT LOW RANK REPRESENTATION

What is the difference between can not and cannot? Although my personal Error Alarm buzzes whenever I see cannot written as two words, both forms are acceptable usage. Merriam-Webster lists cannot as one word. If you try looking up can not in the online unabridged, you will be sent to a list of suggestions headed by cannot. According to the entry in the OED, cannot is the ordinary modern way of writing can not. The historical illustrations given for the negative in the OED shows cannot, can not, and even canot, as well as the contraction cant: ?a1400 Cursor M. (add. to Cott.) p. 959. 105 And ?ou ?at he deed fore cannot sorus be. 1451 Paston Lett. 140 I. 186 Other tydyngs as yett can I non tell you. Ibid. 172 I. 229 Whethir it be thus or non I can not say. 15.. Plumpton Corr. 72, I cannot get my money. 1706 Col. Records Penn. II. 256 The House cant agree to this. 1741 RICHARDSON Pamela I. 56 If he, as you say cant help it. 1742 YOUNG Nt. Th. I. 89 An angels arm cant snatch me from the grave; Legions of angels cant confine me there. 1827 KEBLE Chr. Y. 4 Without Thee I cannot live. Mod. Cant you go? The experts at AskOxford seem to prefer cannot: Both cannot and can not are acceptable spellings, but the first is much more usual. You would use can not when the not forms part of another construction such as not only. The Washington State University language site says: These two spellings [cannot/can not] are largely interchangeable, but by far the most common

is cannot and you should probably use it except when you want to be emphatic: No, you **can not** wash the dog in the Maytag. Bottom line There's no difference in meaning between cannot and **can not**.

e.g  
e g  
e g.  
eg  
eg.  
etc  
et al  
et.al  
et.al.  
etal  
etal.

Both release new albums this month after eight and 11 years away respectively. The two meals cost us 50 and 80 respectively. He earned an M.A. and a Ph.D. from Chicago University in 1968 and 1972 respectively. Steven and James are aged 10 and 13 respectively. Her two daughters, Jo and Fiona, were born in 1968 and 1975 respectively. The storage tanks can hold 50, 100 and 200 litres of fuel respectively. List price of US194andUS 219, respectively. The answers are "four" and "her virginity" respectively. List pricing is US173andUS 310, respectively. The two buildings respectively shall hereinafter be referred to as Building A and Building B respectively. Dialog and Robi are the company's Sri Lanka and Bangladesh operations, respectively.

But that logic has not won favour with the NSF, which in an unusual 7 May statement said the House measure contradicts the goal of increasing US economic competitiveness. The legislation has also displeased groups such as the American Association for the Advancement of Science, the American Geophysical Union, the American Physical Society and the Consortium of Social Science Associations (COSSA). They are among more than two dozen science organizations that have lodged letters of protest with Smith.

That person would never make it to personhood, (or indeed even to a blastocyst,) much less a fetus.

The idea that we only "use" [4] Most of our DNA is; non-coding DNA;—that is, DNA that does not code for the production of proteins. However, that doesn't make it useless—not by a long shot! Some small (amount of it is likely entirely useless, but a great deal of it is anything but DNA does more than just code for protein production. (Some genes regulate other genes—that is, they control when other genes are active, by methylation or other mechanisms. If you lose [genetic regulation and all your coding genes produce proteins at once, you're unlikely to end up with a functional [cell.

Some of the non-coding DNA is translated; into RNA that is not directly translated into the production of proteins, but may assist protein synthesis in other; ways—for example, ribosomal RNA or transfer RNA.

Figure A and Figure B

Figure A, Figure B, and Figure C

Table A and Table B

Table A, Table B, and Table C

Figure A and B

Figure A, B, and C

Table A and B

Table A, B, and C

### III. CONCLUSION

This paper aims at addressing the non-unique-solution issue of LatLRR. On the basis of the theoretical analysis in [1][3][5][7][9][11][13][15][17][19][21], we propose robust LatLRR, which **rst** denoises the data by robust PCA and then chooses the sparsest representation matrix among the solution set of LatLRR with **denoised** data.

### REFERENCES

- [1] R. Vidal, "Subspace clustering," *IEEE Signal Process. Mag.*, vol. 28, no. 2, pp. 52–68, 2011.
- [2] G. Liu, Z. Lin, S. Yan, J. Sun, and Y. Ma, "Robust recovery of subspace structures by low-rank representation," *IEEE Trans. Patt. Anal. Mach. Intell.*, vol. 35, no. 1, pp. 171–184, 2013.
- [3] B. Cheng, G. Liu, Z. Huang, and S. Yan, "Multi-task low-rank affinities pursuit for image segmentation," in *ICCV*, 2011, pp. 2439–2446.
- [4] G. Liu, Z. Lin, and Y. Yu, "Robust subspace segmentation by low-rank representation," in *ICML*, vol. 3, 2010, pp. 663–670.
- [5] G. Liu and S. Yan, "Latent low-rank representation for subspace segmentation and feature extraction," in *ICCV*, 2011, pp. 1615–1622.
- [6] S. Wei and Z. Lin, "Analysis and improvement of low rank representation for subspace segmentation," *arXiv:1107.1561*, 2010.
- [7] E. Elhamifar and R. Vidal, "Sparse subspace clustering," in *CVPR*, 2009, pp. 2790–2797.
- [8] C. Lang, G. Liu, J. Yu, and S. Yan, "Saliency detection by multi-task sparsity pursuit," *IEEE Trans. Image Process.*, vol. 21, no. 3, pp. 1327–1338, 2012.
- [9] E. Elhamifar and R. Vidal, "Clustering disjoint subspaces via sparse representation," in *IEEE Int'l Conf. on Acoustics, Speech, and Signal Process.*, 2010, pp. 1926–1929.
- [10] L. Zhuang, H. Gao, Z. Lin, Y. Ma, X. Zhang, and N. Yu, "Non-negative low rank and sparse graph for semi-supervised learning," in *CVPR*, 2012, pp. 2328–2335.
- [11] E. Candès, X. Li, Y. Ma, and J. Wright, "Robust principal component analysis?" *J. ACM*, vol. 58, no. 3, pp. 1–37, 2011.
- [12] P. Favaro, R. Vidal, and A. Ravichandran, "A closed form solution for robust subspace estimation and clustering," in *CVPR*, 2011, pp. 1801–1807.
- [13] R. Liu, Z. Lin, F. D. L. Torre, and Z. Su, "Fixed-rank representation for unsupervised visual learning," in *CVPR*, 2012, pp. 598–605.
- [14] G. Bull and J. Gao, "Transposed low rank representation for image classification," in *2012 Int'l Conf. Digital Image Computing – Techniques and Applications*, 2012, pp. 1–7.
- [15] H. Zhang, Z. Lin, and C. Zhang, "A counterexample for the validity of using nuclear norm as a convex surrogate of rank," in *ECML PKDD*, 2013.
- [16] T. Zhang, B. Ghanem, S. Liu, and N. Ahuja, "Low-rank sparse learning for robust visual tracking," in *ECCV*, 2012, pp. 470–484.
- [17] Y. Ni, J. Sun, X. Yuan, S. Yan, and L. Cheong, "Robust low-rank subspace segmentation with semidefinite guarantees," in *IEEE Int'l Conf. Data Mining Workshops*, 2010, pp. 1179–1188.
- [18] J. Wright, Y. Ma, J. Mairal, G. Sapiro, and T. S. Huang, "Sparse representation for computer vision and pattern recognition," *Proc. IEEE*, vol. 98, no. 6, pp. 1031–1044, 2010.
- [19] J. Shi and J. Malik, "Normalized cuts and image segmentation," *IEEE Trans. Patt. Anal. Mach. Intell.*, vol. 22, no. 8, pp. 888–905, 2000.
- [20] A. S. Georghiades, P. N. Belhumeur, and D. J. Kriegman, "From few to many: Illumination cone models for face recognition under variable lighting and pose," *IEEE Trans. Patt. Anal. Mach. Intell.*, vol. 23, no. 6, pp. 643–660, 2001.
- [21] P. N. Belhumeur, J. P. Hespanha, and D. J. Kriegman, "Eigenfaces vs. Fisherfaces: Recognition using class specific linear projection," *IEEE Trans. Patt. Anal. Mach. Intell.*, vol. 19, no. 7, pp. 711–720, 1997.