Dear Editor,

We thank the referee for a careful and constructive review of our paper. We apologize for not making our point clear enough in the Section “Reconstruction algorithm”, so readers may misunderstand our method. We would like to point out that we didn’t use the initial position or the real displacements. We use the particle positions for a clear explanation, but we manipulate with the density field. We have added more details in the Section “Reconstruction algorithm”. We hope the referee can reconsider if this paper can be accepted.

Regards,
Hong-Ming Zhu, Ue-Li Pen, and Xuelei Chen

Report of the Referee -- DW11756/Zhu

To be honest, I am struggling to understand the point of this paper and its contribution to the literature. Reconstruction methods are usually used to take an observed galaxy density field and to remove (in part) the damping of the correlation function that arises through large scale bulk motions. If I understand the paper correctly, the authors are proposing reconstructing the initial density field using a knowledge of the non-linear displacements of dark matter particles by calculating the divergence of the displacement field.

Re: Yes, exactly. We reconstructed the displacement field from the nonlinear density field and the negative divergence of the displacement gives the reconstructed density field.

Unfortunately, we do not observe the displacement field directly, so I cannot see how they would implement the method on real data. The authors implement it on simulated data where the true displacements are known; but obviously, if you know the final positions and the true displacements, it is trivial to reconstruct the initial positions, so I cannot see what is gained by taking the gradient of the displacements. (Particularly if they apply an arbitrary smoothing kernel, the effect of which is not really discussed.)

Re: We apologize that we have been too elegant in explaining the reconstruction algorithm. In reality, we didn’t use the information of the initial position of these sheets. We can order the sheets according their Eulerian position from left to right, regardless of their initial Lagrangian coordinates. x_i is the position of the ith particle from the left side of the simulation box. Then we subtract q=iL/N from the x_i, and obtain s(q)=x_i-iL/N. Note that here the particle at x_i may come from q=iL/N and may not. That's why we call q=iL/N is the estimated initial Lagrangian position for the ith sheet at x_i. We don't know the initial position of this particle and we take q=iL/N as a guess. If no shell crossing occurs, the particle preserves their initial order, then the s(q)=x_i-iL/N is accurate to a global shift. Otherwise, this is not accurate and we need more particles to reduce stochasticities as in Eq. (3) of our paper. Reconstruction from the gridded density field can be implemented in a similar way, even the smoothed density field. We have added more details in the Section "Reconstruction algorithm" to explain these.

If the authors are proposing a technique for real observational data, then they should show how it could be applied and compare it quantitatively to other techniques in the literature (in full 3D, with mock galaxies rather than dark matter particles.) On the other hand, if the method can only be applied where you already have all the information, the authors need to explain why the results, in throwing away information, are interesting. In what way do the results of this `reconstruction' illuminate the real reconstruction challenge or the interpretation of those results?

Re: As explained above, we do not have the initial information. This is really a new idea that the displacement is an observable as we show above. The nonlinearities of the displacement field is much better than the nonlinear density field, which gives much more linear BAO information. The 1D case provides an intuitive view of the new method, which is very helpful for understanding the reconstruction algorithm in 3D, which we are now working on. The preliminary calculations in 3D show very good results, since in 1D the nonlinear evolution is much more severe that the 3D case as we discussed in our paper. Also, since we are developing an new method, we should check the results for different fields in different situations (from 1D to 3D, from dark matter particles to halos/galaxies) to better understand the new method.

While the structure and writing of the paper are reasonable, without a clear motivation or application of the method, it is difficult to recommend it for publication.

Re: Thanks a lot for the compliment. We would like to point that we didn't use the initial position and the method has a clear motivation (the displacement is much more linear) and very useful applications (recover BAO information). With the revised Section "Reconstruction algorithm", we hope that the referee can reconsider if this paper can be accepted.