

## Comments to the editor

### Reviewer 1

1. **Comment:** The claim on page 4, line 23: "The results in this paper make it clear that phase unwrapping estimators can be accurate at arbitrarily low SNR" is not true. If it is true, this means that the LSU is able to estimate parameters of a signal corrupted by noise with power 10000 times larger than power of signal, for example. This is not possible.

**Response:**

2. **Comment:** The authors claim (page 4, line 9) that when  $N$  tends to infinity the LSU is accurate for signals with arbitrarily small SNR. Does this claim have practical meaning, since the LSU with K-best method can be used for  $N$  up to 1000?

**Response:**

3. **Comment:** In order to give better performance study of the LSU it is required to determinate the SNR threshold for  $N_i=1000$ . This can be done as in I. Djurovi, M. Simeunovi, S. Djukanovi and P. Wang, "A Hybrid CPF-HAF Estimation of Polynomial-Phase Signals: Detailed Statistical Analysis," IEEE Transactions on Signal Processing, vol. 60, no. 10, October 2012, pp. 5010-5023.
4. **Comment:** Also the calculation complexity of the proposed algorithm is critical. Instead of Fig. 9 (results on figure depend on program realization) it is better to give the calculation complexity of the LSU expressed by big O notation. In this way, one can compare complexity of the CPF or HAF with complexity of the LSU.

## Reviewer 2

1. **Comment:** Change the title. Current title is too general and it does not reflect the paper content.
2. **Comment:** Change claim that the MSE of the estimator can be arbitrary small since it is in the current presentation misleading.
3. **Comment:** Give complexity analysis of compared techniques (big O notation is good enough). For the proposed technique it should be given actual realization of LSU estimator without hiding behind numerous available tools (exact and approximate). The figure giving evaluation time could be removed if space is critical (otherwise it could be kept in the manuscript).
4. **Comment:** Compare obtained results with the product form of the CPF-HAF.
5. **Comment:** Cite several other papers related to the phase unwrapping based estimation of PPS, for example [1] and [2].
6. **Comment:** Clarify simulations. Namely signal where the LSU estimator outperforms other technique seems not satisfying the sampling theorem. For example if  $n=199$  the maximal frequency for signal of the fifth order is far above . Could you clarify this issue?
7. **Comment:** The manuscript is improved from the previous version. It is important for researchers in this field and it could be acceptable for publication after addressing above mentioned concerns. However, some concerns still remain like complexity and not addressing issue of multi-component signals.

## Reviewer 3

1. **Comment:** The paper is an extension of the following ICASSP paper “R. G. McKilliam, B. G. Quinn, I. V. L. Clarkson, and B. Moran, The asymptotic properties of polynomial phase estimation by least squares phase unwrapping, in Proc. Internat. Conf. Acoust. Spe. Sig. Process., Prauge, Czech Republic, May 2011, pp. 35923595, IEEE”. In the revised paper, the authors did not include their ICASSP paper in the bibliography and did not state the technical relevance to that paper in a separate paragraph.
2. **Comment:** The ultimate contribution of this paper is further provided with some lemmas and proofs which really disturbs the flow of the paper. The author should realize that the theme of the TIP is different than mathematical journals such as SIAM, AMS. They should provide the proofs of any lemma, theorems, propositions in a unified appendix.

3. **Comment:** The topic of phase unwrapping is somewhat trivial for one dimensional signal applications, as most of the references for comparison are almost belong to two decades ago. I suggest to the authors to completely change the application into 2D phase unwrapping and, perhaps, further analyze their proposed method in such frameworks. As the authors stated in the paper, this has a good potential to be applied in InSAR, MRI, etc. This is mostly because the phase residues will affect the outcome of unwrapping in low SNR condition. There are good methods in the art to be compared and analyzed.