# Answer to JSTAR reviewers’ comment

ID: JSTARS-2014-00192

Title: Scalar and Representative Observables, and Their Associated Statistical Models, for POLSAR data.

## Reviewer 1:

**Comment:**

**Overall it is an interesting paper but some elements are missing in order to ensure a good repeatability of the results.**

Answer:

The paper has been written with an aim to ensure good repeatability. The proposed PDF can be tested with both Monte Carlo simulations and real-life captured data. Several falsifiable test experiments are illustrated. In fact, readers are welcomed to retry these experiments on different datasets. The authors would be delighted if the reviewer can be specific on what elements can be added to increase the paper’s repeatability or if he had any specific difficulty in retrying these experiments.

**Comment:**

**I am a little bit sceptical about the derivation of the PDF for the ratio (21) in order to get (23). Are you just showing a ratio of chi-squared distributed random variables without actually computing the ratio PDF? Usually the derivation of the PDF of the ratio of independent random variables implies an integration using a Jacobian, therefore some details or reference would be appreciated.**

Answer:

The PDF derivation were prepared in the appendix, but were removed to keep the paper concise. Please find the appendix attached. It should be noted however: that the PDF derivation, as commented by the reviewer, is complex and is not done for every cases of dimension (d) and look (L) numbers. For simple cases, e.g. d=1 the PDFs are derived in the appendix and are presented in the paper in Eqns. (24) to (26).

**Comment:**

**The pdf[] notations could be removed on page 4, since we know that we are dealing with PDFs.**

Answer:

The pdf[] notation is used to differentiate the notation in Eqns. (21) to (23) also in page 4 where, as the Reviewer commented earlier, are not written in PDF format.

**Comment:**

**P4 L55, define the notation in ln(Q)! Is it the Wilk’s lambda distribution?**

Answer:

The notation in this paper stands for our so-called log-chi-squared distribution. It is defined as TODO:INSERT\_EQN and its PDF is derived as TODO:INSERT\_EQN.

It is not the same with Wilk’s distribution. Even though they are probably related in the sense that:

1. If both random variables A&B follow Wishart distribution and can be considered as independent of each other, then
2. The derived observable follows Wishart distribution
3. In this paper we assert that and its log-transformed version (not presented here) follows fixed distributions.
4. Not shown in the submitted paper, but else where TODO:CITE\_THESIS? It is shown that where stands for our so-called log-chi-squared distribution.

To avoid confusion this notation can be changed to in the revised version of this paper, or the equation for ln(Q) is removed from the paper.

**Comment:**

**I am a little surprised that the authors chose to look immediately at real data, I would have expected some Monte-Carlo simulations where the parameter values for various pdfs are perfectly known (in particular L which is estimated here) and uncertainty about sample homogeneity are also absent.**

Answer:

This step is carried out, in various different ways, in our more detailed version describing this work TODO:CITE\_THESIS?. This is kept out of this paper due to the space constraint of this paper.

**Comment:**

**The various histogram maybe easier to display in a log-probability axis especially for the tail behaviour.**

Answer:

Interestingly, our work does include a log-transformed version, which were again removed, in the interest of brevity / space constraint.

**Comment:**

**The various sample sizes should be given as well as the estimated L values.**

Answer:

The sample sizes for AIRSAR and RADARSAT datasets are 50x50 and 300x300 respectively. The computed L values are: TODO:SEARCH\_AND\_FOUND.

**Comment:**

**Section IV, in the multi-dimensional case, it is not clear what analytical relation similar to (26) was used to compute the model PDFs for (22) and (23).**

Answer:

The paper did not use (26) to compute (22) and (23). Rather, it shows that Eqns. (24) to (26) is a special case of Eqns. (17, (22) and (23), where d=1. Thus, the proposed models for POLSAR includes the traditional model for SAR as its special case.

## Reviewer 2:

**Comment:**

**The authors do not show that this parameter is any better than others, such as span, except in the sense that its pdf is defined completely, not just asymptotically.**

Reply:

Apparently the reviewer only see a small portion of the proposed advantages. The paper suggests that its proposed models for multi-dimensional POLSAR also includes the traditional model for SAR as its special case (d=1). Moreover, its scalar observable leads to consistent measures of distance, while other scalar observables, such as span, cannot. Even better are the properties of these proposed consistent measures of distance. First, compared to existing measures of distance (section II.B) the proposed pdf is, as the Reviewer noted, defined completely and not just asymptotically. Second, compared to the widely used intensity-ratio in SAR, the determinant-ratio can be considered as its natural extension in the multi-dimensional case!

**Comment:**

**They also do not acknowledge that much of the useful information in a polarimetric image is in the relationship between the terms of the scattering matrix.**

Answer:

The paper does acknowledge that the proposed model is NOT lossless (P7 L27). One of the thing that is lost may include this intra-relationship among the terms of the scattering matrix. The concerned paragraph will be rewritten (TODO:WRITE).

**Comment:**

**Other parameters they present … are ill-defined in how to put them to practical use.**

Answer:

The paper suggests that the proposed determinant, determinant-ratio or change-ratio models for POLSAR also includes the traditional models for SAR intensity, SAR intensity-ratio and SAR change-ratio. Thus their usage pattern can be learned from the practical use of these SAR models.

**Comment:**

**No comparisons with established procedures are made.**

Answer:

Since the paper did not propose new procedures / application, the authors feel that the ‘’comparison with established procedures” is not needed. The proposed models however are compared with existing models for both SAR and POLSAR and its advantages are shown. For practical application, the paper also includes a portion to illustrate how the proposed models can be useful. Even for this purpose, instead of normal “comparison with established procedures”, a higher-level approach is pursued. Since the proposed determinant, determinant-ratio or change-ratio models for POLSAR also includes the traditional models for SAR intensity, SAR intensity-ratio and SAR change-ratio, the paper shows how to adapt existing SAR data processing techniques towards POLSAR.