

Response to Reviewer Comments

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Our responses to reviewer's comments are written in *Italic letters*. [Blue letters](#) are sentences will reflect in the revised paper taking the comments.

The paper demonstrates, how 3D displacement vectors can be derived from multitemporal, multi-aspect SAR images. The topic and methodology is not new, but the work was performed with sufficient GPS ground truth and is presented clearly, which deserves publication.

Thank you for your comments.

I recommend the following changes before acceptance and final publication:

Specific comments:

- p 2, l 5: It is not only "difficult" to derive 3D information from 2D observations, it is impossible.

Ans.: The manuscript will be revised according to the comment.

- p 3, l 16: I think it not correct, that two InSAR observations deliver 2,5 D information. From two 1D observations we can only derive 2D, if the observation geometry is different (2D). The missing dimension is often amended by model assumptions (e.g. vertical or horizontal motion). The Term 2,5D is often used for DEMs and is not appropriate here.

Ans.: The 2.5 D displacements mentioned here represent the information only from two InSAR pairs. As mentioned in the following manuscript (P3, L17-18), a modeling inversion requires GPS records as additional information.

- p 5, l 12-13: Speckle in general does not reduce the correlation. Indeed it will increase the correlation as long as it is coherent speckle which should be true in urban areas without vegetation. Even if the speckle is incoherent, the correlation process acts as a smoothing filter anyway and reduces the effect of incoherent speckle. Therefore I suspect, the Lee-Filter is irrelevant and even negative because it will destroy coherent speckle correlation. I request the authors to comment on this.

Ans.: We have applied our method on a non-filter pair of images. The results showed that the correlation coefficient of building objects between the non-filter images was less than the filtered images in the same area, which makes smaller number of building shifts could be detected. Also the detected movements from the non-filter images were almost the same as those from the filtered images. Few movements showed only one subpixel (0.25m) difference. According to the comment, we will revise the manuscript as “[The application of an adaptive filter improves the correlation coefficient of two SAR images.](#)”

- p 5, l 17: The 0.3 m accuracy are probably correct and caused by atmosphere and solid earth tides. Recent papers demonstrated that the geolocalization accuracy of TerraSAR-X images can be improved to a few centimeters after correction of atmospheric refractivity and Earth surface dynamics. See: - M. Eineder, C. Minet, P. Steigenberger, X.

Cong, and T. Fritz, "Imaging geodesy - Toward centimeter-level ranging accuracy with TerraSAR-X," *Geoscience and Remote Sensing, IEEE Transactions on*, vol. 49, no. 2, pp. 661–671, 2011 - Xiaoying Cong; Balss, U.; Eineder, M.; Fritz, T., "Imaging Geodesy - A Centimeter-Level Ranging Accuracy With TerraSAR-X: An Update," *Geoscience and Remote Sensing Letters, IEEE*, vol.9, no.5, pp.948,952, Sept. 2012.

Ans.: Thank you for your information. We will consider to improve the geolocation accuracy in the future work.

According to the comment, we will add "Note that the recent papers demonstrated that the geolocalization accuracy of TSX images can be improved to a few centimetres after the correction of atmospheric refractivity and Earth surface dynamics (Eineder et al., 2011; Cong et al., 2012)." in page 5 line 19.

- p 7 l 7: "Two-dimensional displacement detection". This should probably be a new headline.

Ans.: We will separate section 3 into two sections "3. GEONET and field survey" and "4. Two-dimensional displacement detection".

- p 10, l 20: At this point the reader will ask: Why don't you put all observations in one equation system. You are doing this in a later chapter. Please add an explanation at this point why you handle pairs of observations at this point.

Ans.: Since two InSAR pairs with the different geometry are more available than three InSAR pairs, the relationship between the combination and the accuracy could be clarified by comparing the results from two pairs and three pairs. According to the comment, the explanation will be added as "The estimations using two and three pairs results were carried out respectively, to clarify the relationship between the combination condition and the accuracy." in page 10 L11 and "However, the combination of the pairs A and B is enough to estimate the 3D displacements with high accuracy." in page 13 L12.

- p 11, l 3: "similar and stable" are rather unprecise terms. Please quantify or qualify and explain what means "stable".

Ans.: According to the comment, the manuscript will be revised as "The horizontal displacements from these combinations were stable, which means the displacements of neighbouring grids show similar amplitudes and directions."

- p 11, l 22: It is not quite clear to me how the RMS is calculated from which and how many observations?

Ans.: As mentioned in the manuscript, "The Root Mean Square (RMS) errors were calculated for the differences between the analysis results and the GPS records for the three directions." The differences in three directions were represented by one RMS error value.

- p 12, chapter 4.2: This is the obvious methodology for me. As mentioned before: why not immediately go to this step?

Ans.: As the answer in the previous comment, the comparison of two and three pairs help us to clarify the best acquisition condition for the estimation.