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Interactive comment on "Improved finite-source inversion through joint measurements of rotational and translational ground motions: A theoretical study" *by* Michael Reinwald et al.

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The authors greatly appreciate the reviewer's efforts on this manuscript to provide valuable comments and constructive critiques. These critiques have guided us tremendously to revise this manuscript. We have carefully followed the reviewer's suggestions and have made substantial changes in this revised version. The detailed responses to each issue pointed out by the reviewer are answered and commented below.

Page 1, Abstract, Line 3: first sentence - 'seismic source inverse problem' is more proper than just 'seismic inverse problem'

REPLY: We changed the expression to 'seismic source inverse problem'.

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Discussion paper

Page 2, Line 24: (( ))

REPLY: We removed unnecessary brackets.

Page 3, Line 16: /vecm ???

REPLY: We corrected the latex syntax error.

Page 3, Line 19: 'denotes' instead of 'denots'

REPLY: We changed 'denots' to 'denotes'.

Page 3, Line 21: the abbreviation 'pdf' has not been introduced (it should be done in Line 15)

REPLY: We introduced the term 'pdf' in line 15.

Page 3, Line 24: What 26 parameters ?(they have not been specified yet, they are explained later, on Page 5)

REPLY: We generalized the expression to 'for all parameters'.

Page 3, Line 24: Metropolis algorithm ... add citation, e.g., Hastings (1970)

REPLY: We added the suggested citation in the text.

Page 3, Line 26: the these

REPLY: We removed 'the'.

Page 4, Line 12: Are the 44 receivers at the Earth's surface? Are the stress-free conditions taken into account in the calculations? (simplification of the horizontal rotation rate components).

REPLY: Yes, they are all at the Earth's surface and stress-free conditions are taken into account.

Page 4, Line 16 and Fig. 1 caption: not the whole fault but fault trace is illustrated ...

REPLY: We changed 'fault' to 'fault trace'.

Page 4, line 19 and after: the slip model is unclear to me. Are the point sources used only to calculate the average rupture time for each of the subfaults? Is N in Eq. 6 number of subfaults or number of point sources?

REPLY: For clarification, we add the following: We compute a library with the seismic response of each subfault by summing over the previously computed point source seismograms in each subfault, appropriately delayed in time. This library has to be computed only once and contains the seismic wavefield, Gkr corresponding to subfault k, station r. Yes, N is the number of subfaults.

Page 5, Eq. 6: not all the quantities in the equation are described properly in the text

REPLY: We changed the sentence describing the equation: 'The complete seismic response v in the frequency domain at station r summed over all N=24 subfaults with circular frequency \omega = ..., the individual slip amplitude "slip" for each subfault, the rupture velocity "crup", the source time function "S" with the rise time "R" and the Green's function G is expressed in Equation 6.';

Page 5, Line 26: There are already existing rotational sensors capable of measuring in this range of horizontal-component rotation rate amplitudes, e.g. Rotaphones, sixdegree-of-freedom portable seismic sensors (a few references to consider: Brokešová J., Málek J., and J.R. Evans (2012). Rotaphone, a new self-calibrated six-degree-ofC2 freedom seismic sensor, Review of Scientific Instruments, Vol. 83., 086108; Brokešová J. and Málek J (2013), Rotaphone, a Self-Calibrated Six-Degree-of-Freedom Seismic Sensor and Its Strong-Motion Records, Seismol. Res. Let., Vol. 84, No. 5, 737-744; Brokešová J. and Málek J (2015), Six-degree-of-freedom near-source seismic motions II: Examples of real seismogram analysis and S-wave velocity retrieval, J. Seismol., Vol.19, No. 2, 511-539).

REPLY: We added a sentence as clarification and the suggested citations together with

another reference to a rotational instrument developed by IXBlue, Paris: 'Devices that are capable of measuring in this range of horizontal-component rotation rate amplitudes, e.g. Rotaphones, have been developed in recent years.'

Page 6, Line 8: it should be noted that Fig. 5 correspond only to Scenario 1 (strike-slip) and regular station distribution.

REPLY: We changed the last part of the sentence to '... the results for both inversions for the 24 slip amplitudes in Scenario I with a regular station distribution. '

Table 1, Caption: The largest difference in information gain...? What difference? between the 6C and 3C cases? Than it is the shallowest subfault layer.

REPLY: We changed it to 'The largest ratio of information gain increase for the slip amplitude between the 6C and the 3C inversion is in the ....'.

Figs. 5,6,7,8: vertical axes should be labeled.

REPLY: We labeled the y label to 'Relative posterior likelihood'.

Page 7, Line 6 and Fig. 8: improvement (6C vs. 3C) in resolving rupture velocity is not convincing.

REPLY: We changed the text to: 'There is, nevertheless, an improvement in resolving the true value with the 6C inversions for the rise time. For rupture velocity we do not see an improvement regarding the maximum of the posterior pdf.'

Fig. 7 and 8: What is the fault dip? (Page 5, Line 13: dip varying from 90 to 45 degrees is mentioned; it seems to me that the authors originally intended to consider several dip values but in fact present only the normal-fault case - it should be clarified).

REPLY: With the following definition of dip: Fault dip is the angle between the fault and a horizontal plane, 0° to 90°. And the following definition of rake: Rake is the direction a hanging wall block moves during rupture, as measured on the plane of the fault. It is measured relative to fault strike, ±180° Our Scenario I has a dip of 90° and a rake of

0° and our Scenario II has a dip of 45° and a rake of -90°. We added the following line to the text clarifying the definition of dip: '... (angle between the fault and the horizontal plane) ...'

Page 7, Line 12: "because more receivers are selected north and south of the fault than in east and west direction." ... i didn't catch the sense of this sentence.

REPLY: We changed the mentioned part to 'because the regular receiver distribution leads to larger number of receivers lying north and south of the fault than east and west of the fault.'

Page 8, Line 12: 'calculated' instead of 'measured' (synthetic study).

REPLY: We changed the word to 'calculated'.

Page 9, Line 32: The sentence starting " This applies ..." is unclear.

REPLY: We changed the sentence to 'This applies not only to finite source inversions, which are a crucial part of seismological research, but probably to all work related to earthquake source inversions that relies on data recorded by seismic receivers.'.

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