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Interactive comment on "Structural and Seismic Monitoring of a Monumental Building: the Case Study of the Royal Castle of Racconigi" *by* Gianni Niccolini et al.

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We would like to thank the Referee for his precious and valuable suggestions. The answers to the referees points are presented here below. In the attached pdf file, we have included the revised copy of the manuscript with all suggested changes highlighted with a yellow background.

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Authors: Gianni Niccolini, Alberto Carpinteri, Amedeo Manuello, Elena Marchis

Title: "Structural and Seismic Monitoring of a Monumental Building: the Case Study of the Royal Castle of Racconigi"

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Discussion paper

1. STRUCTURE OF THE MANUSCRIPT Referee comment: To my opinion the length of Section 2 is disproportionally long [. . .]. The section should be drastically shortened, most of its figures must be removed, and then it could become part of the Introduction. On the contrary Section 4 should be analyzed according to a much more detailed manner. Quite a few details concerning the way the raw data were processed are missing. Authors' reply: Section containing architectural and historical details has been suppressed. Relevant information concerning the historical building and the structural element under monitoring became part of the Introduction, and we have removed figure 1 from the manuscript. On the other hand, we have given more experimental details, concerning data acquisition and data processing, in Section 2, now titled "Experimental results", and in Section 3, "Frequency and natural time analysis of AE time series and correlation with nearby seismicity". In Section 2, we have specified: âĂć the type of the adopted transducers ("broad-band type, working in the range 10 kHz – 1 MHz"); âĂć the accuracy of the arrival time of signals ("0.2 μs"); âĂć the criterion used for determination of noise amplitude ("Before starting the monitoring, the background noise has been checked for a representative period of time, i.e. 24 hours, in order to determine the level of spurious signals: [. . .] 1.5 mV").

Further changes are reported in the following points.

2. THE TITLE OF THE MANUSCRIPT Referee comment: The title of the contribution is somehow misleading or overambitious. The authors did not monitor a Monumental Building but rather a specific structural element of the building. Moreover the technique (Acoustic Emission) used to monitor the element should be somehow reflected in the title and the same is true for the analysis technique (Natural time). Authors' reply: The title of the manuscript has been changed as follows: "Frequency and natural time analysis from acoustic emission monitoring of an arched structure in the Racconigi Castle".

3. ADOPTED ASSUMPTIONS THAT MUST BE JUSTIFIED Referee comment: This is, for example, the case of the statement "In particular, the increased AE rate marked

by a vertical dashed line in the top diagram of Fig. 5 can be regarded as a signature of unstable damage accumulation" (p.7, lines 5-7). I am not convinced that any increase of the AE rate is a sign of unstable damage accumulation. Authors' reply: We added the following statement in Section 2: "[. . .] Since all possible noisy signals in the frequency and amplitude range of measurement have been minimized, the burst of AE activity, marked by a vertical dashed line in the top diagram of Fig. 4, can be reasonably correlated with sudden increase in damage accumulation."

Referee comment: Along the same line the authors should justify their choice for ". . . partitioning the time window preceding the considered seismic event into three sub-intervals (0-80h; 80h-285h; 285h-485h) roughly containing the same number of AE events" (p.11, lines 6-9). What is the criterion for dividing the overall time interval into three sub-intervals and why the specific ones were chosen? Authors' reply: We added the following statement in Section 3: "We have chosen the following sub-intervals: (0h, 50h); (90h, 190h); (260h, 485h) characterized by different stages of the AE activity separated by quite long silent periods. The first interval, (0h-50h), contains a sudden increase in the AE rate, followed by two intervals, (90h, 190h) and (260h-485h), with smoother AE rates."

4. SOME QUALITATIVE STATEMENTS AND CONCLUSIONS SHOULD BE QUANTIFIED Referee comment: For example it is stated that ". . .a progressive reduction of the highest frequencies, i.e., between 400 and 800 kHz, is observable as the seismic event was approached" (p. 11, lines 9-10). What is the magnitude of this reduction? Is this reduction significant and on what basis of comparison? Authors' reply: We added the following statement in Section 3: "The reduction is given in percentage terms, 30%, 22% and 16% of the total amount of signals for each distribution."

5. SOME TYPING ERRORS MUST BE CORRECTED AND SOME SENTENCES SHOULD BE REPHRASED Referee comment: Although from a linguistic point of view the manuscript is very well written, some points must be considered, as follows: 5.1 p.6, lines1-2. The sentence should be rephrased. 5.2 p.8, line 17. The sentence

contains a duplication of words. 5.3 p.8, lines 22-26. This is a very long sentence and must be rephrased. 5.4 p.12, line 1: “On the other hands” must be written “On the other hand”. Authors’ reply: 5.1 p.6, lines1-2. The sentence has been rephrased as follows: “Damage assessment in an arch of castle’s thermal bath (Fig. 1) has been carried out by the AE technique, as a first step to plan possible restoration interventions. [. . .] The examined architectural element, currently supported by a steel frame structure, is a masonry arch with a span of 4 meters exhibiting a relevant crack pattern.” 5.3 p.8, lines 22-26. The sentence has been rephrased as follows: “Here, the damage evolution of a structural element is investigated by analyzing the AE time series using two different methods and comparing the results. First, the evolution of variance $\kappa 1$ and entropy S of the natural-time transformed time series { χk } is studied, where the energy Qk associated with the AE event amplitude Ak is given by Qk = Ak1.5, similarly to seismology (Kanamori and Anderson, 1975; Turcotte, 1997). The second method used is the analysis of evolving AE signal frequencies over the monitoring time (Gregori et al., 2004; Gregori et al., 2005; Schiavi et al., 2011).”

Please also note the supplement to this comment:
http://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2016-374/nhess-2016-374-AC1-supplement.pdf

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