Maria Sklodowska-Curie Actions (MSCA)
Innovative Training Networks (ITN)
H2020-MSCA-ITN-2018
Grant number 813137

Project number 813137

URBASIS-EU
New challenges for Urban Engineering Seismology

MILESTONE

Work Package: WP1
Number: M17 – Physics-based scenarios in Cities

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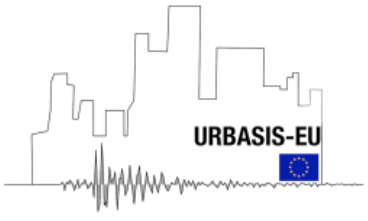

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1. Introduction

The research activity of POLIMI, involved in the URBASIS project (ESRs 1.3 and 3.4), aims at making progress on physics-based numerical simulations of earthquake ground motion, with relevant implications for site-specific seismic hazard and risk assessment studies in urban areas. The numerical simulations are carried out using SPEED – SPectral Elements in Elastodynamics with Discontinuous Galerkin (Mazzieri et al. 2013, http://speed.mox.polimi.it/), a high-performance open-source computer code suitable for large-scale seismic wave propagation problems from the seismic fault to the site and, eventually, to the buildings (see URBASIS Deliverable 3.5 for the latest developments of SPEED in numerical algorithms to couple ground motion simulation with reduced models of nonlinear structural response). In the framework of the URBASIS project, a strong-motion dataset of near-source broadband earthquake ground motions from 3D physics-based numerical simulations—named BB-SPEEDset (v 1.0)— is made available to all project's participants. The main features of BB-SPEEDset are summarized in the following Section.

2. BB-SPEEDset (v 1.0)

BB-SPEEDset is a dataset of near-source broadband earthquake ground motions from 3D physics-based numerical simulations (see overview in Paolucci et al. 2021). BB-SPEEDset has been constructed by assembling a large set of waveforms simulated by SPEED in many cities worldwide, in most cases validated against earthquake recordings, and post-processed with an effective workflow suitable to generate broadband accelerograms. The generation of broadband time histories starting from low-frequency SPEED results makes uses of a technique based on Artificial Neural Networks – ANN2BB (Paolucci et al. 2018), trained on strong motion recordings. The first release of BB-SPEEDset includes a total of 12058 three-component waveforms and corresponding flatfile from earthquake scenarios in different areas worldwide with moment magnitude (MW) from 5.5 to 7.4 and JoynerBoore distances (RJB) up to 80 km (see Figure 1). In Paolucci et al. (2021) it has been demonstrated that the near-source ground motion features in BB-SPEEDset, ranging from the attenuation with distance, the statistical distributions of peak and integral intensity measures, to directionality and impulsive effects, are consistent, in similar magnitude and distance ranges, with those from recorded strong motion dataset (namely, the NEar-Source Strong-motion flat-file – NESS2.0, Sgobba et al. 2021).

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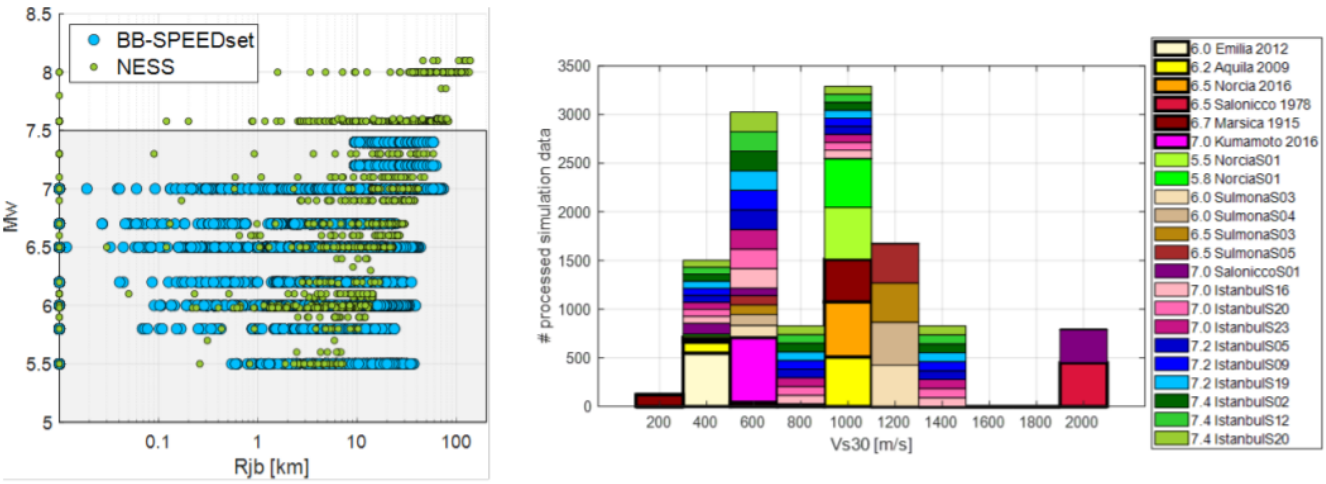

Figure 1 BB-SPEEDset: dataset distribution with respect to M_W, R_{JB} (left) and V_{S30} (right).

BB-SPEEDset is available to any interested end-user at the following link http://speed.mox.polimi.it/bb-speedset/ as two files:

• *BB-SPEEDset_v1.0_flatfile*: flatfile including the metadata regarding the source, source-to-site distances, site response proxies, post-processing method and a large portfolio of ground motion intensity measures. The format of the flatfile is consistent with the most up-to-date flatfiles of strong motion recordings (e.g. NESS2.0 http://ness.mi.ingv.it/).

• *BB-SPEEDset_v1.0_accelerograms*: complete set of simulated three-component broadband accelerograms corresponding to the flatfile.

When used, BB-SPEEDset shall be cited as follows:

Paolucci R., Smerzini C., Vanini M. (2021). BB-SPEEDset: a validated dataset of broadband near-source earthquake ground motions from 3D physics-based numerical simulations. Bulletin of Seismological Society of America, 111 (5): 2527–2545.

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Sgobba, S., C. Felicetta, G. Lanzano, F. Ramadan, M. D'Amico, and F. Pacor (2021). NESS2.0: An updated version of the worldwide dataset for calibrating and adjusting ground motion models in near-source. Bulletin of Seismological Society of America,111 (5): 2358–2378.