Utilization of genetic algorithm to find optimal geometric shape for seismic barriers

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The paper will present the developed genetic algorithm to search for optimal shape of a barrier that is used to protect buildings and structures from oncoming surface waves of seismic origin. Seismic barrier is a structure built inside soil and is usually surrounding the area to be protected from potential seismic hazard. Depending on materials used for the construction of a seismic barrier and its geometric dimensions and shape, in many cases, the barrier can secure significant reduction of magnitudes of displacements and accelerations inside the protected area. The goal of the presented research is to find optimal geometric shape for a barrier, resulting in maximum possible reduction of amplitudes of displacement behind the barrier. The dimensions of a domain that can potentially be occupied by a barrier are fixed. Any point of this domain can be either soil or a material with properties that are very different form the soil ones. In these conditions, finding the best possible barrier shape using brute force will mean performing 2^{1800} computations, which will require unrealistically long computational time as one computation typically takes 5-10 minutes utilizing dual xeon gold 6248R workstation. It will be demonstrated that the developed approach based on genetic algorithm is able to find geometry that is very close to optimal one in less than 1000 computations. Similar approach can also be successfully utilised to find optimal properties for seismic metamaterials and in many other problems involving evaluation of optimal geometric shape in formulations without a possibility to develop analytic solution. This study was supported by the Russian Science Foundation, Grant 20-11-20133.