Recent years show an increasing interest in scientific research related to characterization of physical phenomena occurring in media with discontinuities. Significant part of this research is related to inhomogeneous media a good example of which are composite materials increasingly used in contemporary engineering. Composite materials have found many applications and have been successfully used to manufacture critical structural components replacing metals and alloys used heretofore for this purpose. Often offering similar or better mechanical properties. Composite materials are however prone to delaminations and debondings that can be induced during the manufacturing or service periods. These damages are very dangerous not only because they impair the mechanical properties of a material but primarily because they may lead to critical damage of a structure causing loss of human life or health as well as financial losses. In relation to this, there is a significant research effort directed towards the understanding of physical phenomena occurring when discontinuities in these media form and evolve. Of special interest is the research related to local nonlinearities, which allow not only to detect the presence of discontinuity but also to find its location. The prominent member of the local nonlinear phenomena family are local resonances of discontinuities, being the subject of this proposal.

The concept of local resonance at the macro scale is based on the fact that local stiffness of a material can be greatly reduced in the presence of a discontinuity. As a result, such area has its own characteristic frequency of vibration. It has been shown in the literature, also in the research done by the applicant, that the use of local resonance phenomenon brings significant advantages for nonlinear acoustics tests used to detect a nonlinear response of a material. In case of engineering materials, including composites, nonlinear response of a material in the stress-strain domain for low strain values can be identified with the presence of discontinuities. The use of local resonances in these nonlinearity tests allows to obtain significant nonlinear responses due to only low energy excitation. Thanks to this, such nondestructive diagnostics becomes much more effective. Another advantage is that the nonlinear response can be observed not only in the strain field but also in the surrounding acoustic cavity and in the thermal field. The problem is, however, the determination of local resonant frequencies of discontinuities.

Nowadays, most research works describing the local resonances at the macro scale are based on experimental observations. There exist also theoretical models of local resonances of discontinuities, but they contain a series of simplifications which makes them of limited use for practical applications. There are no models for more realistic cases taking into account irregular shapes of discontinuities which may drastically change resonant frequencies. In addition, the boundary conditions and stress field in the material are not being considered in these models. This is especially critical for inhomogeneous media where lack of symmetry influences local resonant conditions and complicates the problem. Another important issue is the coupling between the strain field and the temperature field around a discontinuity in resonant conditions. The abovementioned issues indicate that **there is a need to elaborate models allowing to model and identify local resonances in inhomogeneous structures with discontinuities.**

As a result, **the main goal of the proposed research project is the characterization of the local resonance phenomenon in inhomogeneous media with discontinuities.** We intend to obtain this goal by the: analysis of origination of local resonances in inhomogeneous media with discontinuities; elaboration of local resonance models considering the morphology and location of discontinuities; analysis of coupling between the strain field and the temperature field around a discontinuity in resonant conditions and elaboration of a technique to selectively excite local resonances and utilize them to analyze the nonlinear response of materials. **Eventually, the knowledge resulting from the basic research proposed in this project will be the starting point for the development of nondestructive damage detection techniques that could be used in inhomogeneous media where the classical nondestructive testing fail.**