

## Nonlinear dynamics of the sensory element of the atomic force microscopy

**Pavel Udalov**

*Abstract:* In this paper, a microscope with a sensitive element in the form of a cantilever beam operating in the frequency contact mode. The problem of obtaining approximate analytical expressions describing the dynamics of the sensitive element in the case of forced oscillations, taking into account the pre-stressed state caused by static deformation and non-linear force of interaction with the sample. Asymptotic and variational methods of mathematical physics, a model is constructed and estimates are obtained, the result is compared with a numerical solution by the finite element method. The key focus in this work is the analysis of the nonlinear dynamics of the sensitive element of an atomic force microscope and the selection of the information signal from the nonlinear effects associated with the interaction of the indenter and the sample. It is interesting and practically important to conduct a qualitative analysis of the dynamics of a sensitive element using asymptotic methods of the nonlinear theory of oscillations, and to obtain final analytical expressions and curves that could serve as a basis for highlighting useful signal. Due to the generality of the method, the range of applicability of these results would not be limited to an atomic force microscope, and they would also prove useful in designing gyroscopic instruments.

---

<sup>1)</sup> Pavel Udalov, B.A.: Peter the Great St.Petersburg Polytechnic University, Russia, 195251, St.Petersburg, Polytechnicheskaya, 29, Russia (RU), forsteam1231@mail.ru .