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Departamento de Matemática
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Touchdown localization for the MEMS problem with variable dielectric permittivity.

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We consider a well-known model for micro-electromechanical systems (MEMS) with variable dielectric permittivity, based on the following parabolic equation with singular nonlinearity

$$\begin{cases} u_t - \Delta u = f(x)(1-u)^{-p}, & x \in \Omega, \quad t > 0, \\ u = 0, & x \in \partial\Omega, \quad t > 0, \\ u(0,x) = 0, & x \in \Omega, \end{cases} \tag{0.1}$$

where Ω is a smooth bounded domain in $\mathbb{R}^n$, $n \geq 1$, $p > 0$ and $f \geq 0$ is a Hölder continuous function.

We study the eventually apparition of singularities in the nonlinear part of the equation. This phenomenon is known as quenching or touchdown. Recently, the question whether or not touchdown can occur at zero points of the permittivity profile f, which had long remained open, was answered negatively in [3] for the case of interior points.

Our aim in [1] is to go further by considering the same question at points of positive but small permittivity. As one of our main results, in any space dimension, we show that touchdown cannot occur at an interior point where the permittivity profile is suitably small. We also obtain a similar result in the boundary case, under a smallness assumption of f in a neighborhood of the boundary.

Moreover, in view of practical considerations of MEMS design, in [2] we give special care to express our smallness conditions in a *quantitative way*, especially in one space dimension, where analytic computations can be made more precise.

We also obtain another kind of results regarding further properties of the touchdown set, some of them locating it far away from the maximum points of f, which confirm the necessity of some kind of smallness condition on f if one wants to prevent touchdown in certain regions of the domain.

References

[1] C. Esteve, Ph. Souplet, No touchdown at points of small permittivity and nontrivial touchdown sets for the MEMS problem, *To appear in Advances in Differential Equations.* Preprint arXiv:1706.04375. `https://arxiv.org/abs/1706.04375`.

[2] C. Esteve, Ph. Souplet, Quantitative touchdown localization for the MEMS problem with variable dielectric permittivity, *To appear in Nonlinearity.* Preprint arXiv:1710.04035. `https://arxiv.org/abs/1710.04035`.

[3] J.-S. Guo, Ph. Souplet, No touchdown at zero points of the permittivity profile for the MEMS problem, *SIAM J. Math. Analysis* 47 (2015), 614–625.

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