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Aviles-Giga type functionals calibrated with the help of currents

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For vector fields in a two-dimensional domain, consider a Modica-Mortola (or Allen-Cahn) type functional. We do not make any specific assumptions on the wells of the potential function (so there may be multiple single-point wells or one or several more complex wells), but we do assume that the divergence of the vector fields is quite strongly penalised or even vanishes identically. This then gives rise to a situation similar to the Aviles-Giga functionals.

As for other Modica-Mortola type problems (or as for the classical Aviles-Giga problem), when we let the relevant parameter tend to 0, we expect a limit that takes values in the wells of the potential function, but there can be transitions between different values. We want to find out how much energy is required for such a transition.

Our strategy is to find suitable functions, called calibrations, which measure the energy of a transition layer. This is not a new idea, but we take it in a somewhat different direction. When asking for the optimal calibration for a given potential function, we are led to a variational problem involving the L-infinty norm of the gradient. Such problems are difficult to study, but using recent ideas of Katzourakis and myself, we can encapsulate the essential information in a geometric variational problem. Solving the latter can still be difficult, but we finally obtain an answer at least in some cases.

This is joint work with Radu Ignat (Toulouse).

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