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Relaxation of Variational Functionals with Piecewise Constant Growth Conditions

We study the lower semicontinuous envelope of variational functionals given by $\int f(x, Du)\, dx$ for smooth functions u, and equal to $+\infty$ elsewhere, under nonstandard growth conditions of (p, q)-type: namely, we assume that

$$|z|^{p(x)} \leq f(x, z) \leq L(1 + |z|^{p(x)}).$$

If the growth exponent is piecewise constant, i.e., $p(x) \equiv p_i$ on each set of a smooth partition of the domain, we prove measure and representation property of the relaxed functional. We then extend the previous results by considering $p(x)$ uniformly continuous on each set of the partition. We finally give an example of energy concentration in the process of relaxation.