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On Strong Pseudomonotonicity and (Semi)strict Quasimonotonicity

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Abstract. An example in Ref. 1 is corrected to show that indeed a strongly pseudoconvex function, which is only once but not twice differentiable, does not necessarily have a strongly pseudoconvex gradient.

Key Words. Strongly pseudoconvex functions, strongly pseudomonotone maps.

The function

$$f(x) = \int_0^x \xi |\sin(1/\xi)| \, d\xi$$

is not an example of a strongly pseudoconvex function whose derivative is not strongly pseudomonotone, as stated in Example 3.1 of Ref. 1. Indeed, f' vanishes infinitely many times in any neighborhood of 0; so, f is not even pseudoconvex. We thank M. Bianchi for this remark. To provide such an example, we consider instead the function

$$g(x) = \int_0^x \xi(|\sin(1/\xi)| + |\xi|) \, d\xi.$$

Then,

$$g'(x) = 0, \qquad \text{if and only if } x = 0.$$

By the calculation in Ref. 1, p. 148, we know that there exists $c > 0$ such that

$$f(x) > cx^2/2, \qquad -1/\pi \leq x \leq 1/\pi.$$

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Since

$$g(x) \geq f(x),$$

we deduce that $g(x)$ is strongly pseudoconvex. In addition,

$$g'(1/k\pi) = 1/k^2\pi^2, \qquad k \in N.$$

Hence, there are no $\epsilon > 0$, $\beta > 0$ such that

$$g'(x) \geq \beta x, 0 \leq x < \epsilon;$$

so, g' is not strongly pseudomonotone.

Reference

1. HADJISAVVAS, N., and SCHAIBLE, S., *On Strong Pseudomonotonicity and (Semi)-strict Quasimonotonicity*, Journal of Optimization Theory and Applications, Vol. 79, pp. 139–155, 1993.