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"The pullback equation and Darboux theorem"

We discuss the existence of a diffeomorphism $\varphi : \mathbb{R}^n \to \mathbb{R}^n$ verifying

$$\varphi^* (g) = f$$

where f, g are closed differential $k-$forms. Componentwise the equation reads as

$$\sum_{1 \leq i_1 < \cdots < i_k \leq n} g_{i_1 \cdots i_k} (\varphi (x)) \, d\varphi^{i_1} \wedge \cdots \wedge d\varphi^{i_k} = \sum_{1 \leq i_1 < \cdots < i_k \leq n} f_{i_1 \cdots i_k} (x) \, dx^{i_1} \wedge \cdots \wedge dx^{i_k}.$$

1) We start by considering the case $k = 2$, generalizing the celebrated Darboux theorem in two directions. First we obtain optimal regularity in Hölder spaces for the local problem and then, under some necessary additional hypotheses, we get global existence as well as regularity. We thus extend to $2-$forms the results of Moser and Dacorogna-Moser obtained for the case of volume forms $k = n$.

2) We will then discuss the easier case $k = n - 1$.

3) Finally we will make some comments on the more difficult problem of $k-$forms, when $3 \leq k \leq n - 2$.

[1] Bandyopadhyay S. and Dacorogna B., On the pullback equation $\varphi^* (g) = f$, *Ann. Inst. Henri Poincaré, Analyse Non Linéaire*, **26** (2009), 1717-1741.

[2] Bandyopadhyay S., Dacorogna B. and Kneuss O., The pullback equation for degenerate forms, *Disc. Cont. Dyn. Syst. Series A*, **27** (2010), 657-691.

[3] Dacorogna B. and Kneuss O., Divisibility in Grassmann algebra, to appear in *Linear and Multilinear Algebra*.