

An exotic zoo of diffeomorphism groups on \mathbb{R}^n

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Let $C^{[M]}$ be a (local) Denjoy–Carleman class of Beurling or Roumieu type, where the weight sequence $M = (M_k)$ is log-convex and has moderate growth. Let \mathcal{A} stand for any of the following classes of mappings:

- $\mathcal{B}^{[M]}$ (global Denjoy–Carleman),
- $W^{[M],p}$ for $p \geq 1$ (Sobolev–Denjoy–Carleman),
- $\mathcal{S}_{[L]}^{[M]}$ (Gelfand–Shilov),
- $\mathcal{D}^{[M]}$ (Denjoy–Carleman with compact support).

We prove that the groups $\text{Diff } \mathcal{A}(\mathbb{R}^n)$ of $C^{[M]}$ -diffeomorphisms on \mathbb{R}^n which differ from the identity by an \mathcal{A} -mapping are $C^{[M]}$ -regular Lie groups. As an application we obtain well-posedness of the Hunter–Saxton PDE on the real line in some (extensions) of the above spaces. Hereby we also find some surprising groups with continuous left translations and $C^{[M]}$ right translations.