UPPER BOUND FOR
MULTI-PARAMETER ITERATED COMMUTATORS

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Abstract: We show that the product BMO space can be characterized by iterated commutators of a large class of Calderón–Zygmund operators. This result follows from a new proof of boundedness of iterated commutators in terms of the BMO norm of their symbol functions, using Hytönen's representation theorem of Calderón–Zygmund operators as averages of dyadic shifts. The proof introduces some new paraproducts which have BMO estimates.