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**Tim Austin\*** ([tim@cims.nyu.edu](mailto:tim@cims.nyu.edu)), Courant Institute, New York University, 251 Mercer St, New York, NY 10012. *Partial difference equations over compact Abelian groups.*

Given a compact Abelian group  $Z$ , an element  $z$  of that group, and a measurable function from it to another such group, one can form a new function by taking the difference of the original function and its translate by  $z$ . This is the obvious discrete analog of differentiation, and defines an operator on functions called a differencing operator.

Recent work in additive combinatorics, related to Gowers' proof of Szemerédi's Theorem, leads naturally to the study of certain 'higher-order' partial difference equations involving such operators. Given several elements of  $Z$ , one asks for a description of those functions on  $Z$  which vanish when one applies all of the resulting differencing operators. It turns out that as the order of the difference equation increases, one can sometimes find surprising extra structure among these solutions, which amounts to a first step towards understanding the inverse problem for the 'directional Gowers norms'. (Received September 05, 2013)