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Armenak Petrosyan* (armenak.petrosyan@vanderbilt.edu), 1906 Chet Atkins Place, Apt 601, Nashville, TN 37212, and **Akram Aldroubi** (akram.aldroubi@vanderbilt.edu), 1520 Stevenson Center, Vanderbilt University, Nashville, TN 37240. *Frames and Bessel systems generated by the iterative actions of normal operators.*

We consider systems of vectors of a form

$$\{A^n g_i : i \in I, n \geq 0\}$$

where $\{g_i\}_{i \in I}$ is a countable (finite or infinite) subset of a separable Hilbert space \mathcal{H} and $A \in B(\mathcal{H})$ is a normal operator. We show that a system of that form can never be complete and minimal and find conditions that the operator A needs to satisfy for the system to be complete and Bessel.

We also investigate systems of a form

$$\{\pi(\gamma)g_i : i \in I\},$$

where π is a unitary representation on \mathcal{H} of the discrete group Γ and extract information about the spectrum of the operators in the group when the system is minimal or complete and Bessel. (Received February 06, 2016)