We study a certain random process on a graph $G$ which is a variation of a classical voter model and is also a special case of the so-called Tsetlin library random walk. Initially each vertex of $G$ is colored either blue or red.

At each step an edge is chosen at random and both endpoints change their colors to blue with probability $p$ and to red otherwise. This edge-flipping process corresponds to a random walk on the associated state graph in which each coloring configuration is a node. We show that the eigenvalues for the random walk on the state graph can be indexed by subsets of the vertex set of $G$. For example, for the uniform case of $p = 1/2$, for each subset $T$ of the vertex set $V$ of $G$, the eigenvalue $\lambda_T$ (with multiplicity 1) is the ratio of the number of edges in the induced subgraph of $T$ divided by the total number of edges in $G$. We analyze the stationary distribution of the state graph of colorings of $G$ for several special families of graphs, such as paths, cycles and trees. We also mention related problems in connection with memoryless games.

This is a joint work with Ron Graham.