1147-05-642   **Woong Kook** (`woongkook@snu.ac.kr`) and **Kang-Ju Lee*** (`leekj0706@snu.ac.kr`). *Kirchhoff index of simplicial networks.*

We introduce a high-dimensional analogue of Kirchhoff index which is also known as total effective resistance. This analogue, which we call simplicial Kirchhoff index $Kf(X)$, is defined to be the sum of the simplicial effective resistances of all $(d+1)$-subsets of the vertex set of a simplicial complex X of dimension d. For a d-dimensional simplicial complex X with n vertices, we give formulas for the simplicial Kirchhoff index in terms of the pseudoinverse of the Laplacian L_X in dimension $d-1$ and its eigenvalues:

$$Kf(X) = n \cdot \operatorname{tr} L_X^+ = n \cdot \sum_{\lambda \in \Lambda_+} \frac{1}{\lambda},$$

where L_X^+ is the pseudoinverse of L_X, and Λ_+ is the multi-set of non-zero eigenvalues of L_X. Using this formula, we obtain an inequality for a high-dimensional analogue of algebraic connectivity and Kirchhoff index, and propose these quantities as measures of *robustness* of simplicial complexes. In addition, we derive its integral formula and relate this index to a simplicial dynamical system. We present an open problem for a combinatorial proof of our formula by relating the combinatorial interpretation of R_σ to rooted forests in higher dimensions. (Received January 27, 2019)