The paper presents the application of DIRECT algorithm to analyse the performance of the Self-excited induction generator (SEIG). To the author best knowledge, this is the first attempt to apply it to such a problem. DIRECT algorithm is used to minimize the induction generator's admittance without the need to separate it into its real and imaginary parts. No initial guess is required as it needs only the upper and lower values of the unknown variables which are easily determined. The obtained minimum admittance yields the adequate magnetizing reactance and the frequency. These two key parameters are then used to compute the self-excitation process requirements in terms of the prime mover speed, the capacitance and the load impedance on the one hand and to predict the generator steady state performance parameters on the other. Very good agreement between predicted results and experimental measurements is achieved