In order to address the need in the field of single electronics for a physically small (nanometer scale), but highly resistive conductor featuring “quasi-continuous” charge transfer, two-dimensional disordered systems exhibiting electron hopping transport are Monte Carlo simulated with an emphasis on analyzing charge transport through the device. Previous results have indicated high resistivity for hopping systems, and now they are shown to satisfy the two conditions necessary for “quasi-continuous” charge transfer.

Major Findings:
- More complete and/or accurate results for 2D hopping current
- Detailed characterization of hop length statistics
- Frequency \( f \) dependence of current noise; for substantial Coulomb, evidence of \( 1/f \)-noise at \( T = 0 \)
- Shot noise suppression with length \( L \); negligible Coulomb: \( F \propto L^{-0.76\pm0.08} \) rather than \( 1/L \)
- Percolation cluster length \( L_c \) as a function electric field \( E \)
- Charge relaxation dynamics through 2D hopping conductor; good mean-field description at \( |Q| > e \)
- Residual charge statistics at \( T \to 0 \); universal scaling for negligible and substantial Coulomb
- Derivation of the universal scaling for negligible Coulomb