An earthquake is a complex phenomenon where a lot of unsolved problems remain. The present thesis deals with a numerical study of earthquakes based on a statistical model called the Burridge-Knopoff (BK) model, performed to clarify the statistical properties of earthquakes. In the past, many works have been made based on the BK model, and the model brought us a lot of interesting information. The analysis concerning its spatio-temporal correlations, however, has been lacking so far. Hence, in the present thesis, we investigate the statistical properties of earthquakes paying particular attention to the seismic spatio-temporal correlation functions of the BK model. Numerical simulations of the one- and two- dimensional short-range BK models are performed to investigate their spatio-temporal correlation functions, in addition to the magnitude distribution, including the recurrence-time distribution, the time development of the seismic space-correlation function before and after the mainshock, the time development of the magnitude distribution function before and after the mainshock, *etc.,* for a wider range of model parameters than studied earlier in the previous works.

Since an earthquake is a stick-slip instability of a fault, its statistical properties are expected to be governed by the friction law, or the constitutive law, of the fault. As the form of the friction force of the fault, we assume the velocity-weakening friction force. This friction force includes a parameter α representing the rate of the friction force getting weaker on increasing the sliding velocity. We have found that the model exhibits several distinct "phases" according to the α-value. We then investigate the properties of seismic spatio-temporal correlations in each "phase" of the BK model.

Most of the previous works on the BK model have assumed that the inter-block interaction works only between nearest-neighboring blocks (the short-range model). This corresponds to the situation where a thin isolated plate is subject to the friction force and is driven by the sheer force. Considering the effect of extended elastic body adjacent to the fault plane amounts to considering the effective inter-block interaction to be long-ranged. In order to represent an earthquake fault more realistically, we also perform a similar numerical analysis of seismic spatio-temporal correlations based on the long-range BK model in both one- and two-dimensions. In the BK model, the original continuum crust is discretized into blocks and it is obviously important to examine the validity of this block discretization. For this purpose, we also introduce the Kelvin viscosity term into the BK model. By taking account of the viscosity in this way, not only the model becomes more realistic but also the continuum limit of the model can be well taken. We then investigate the statistical properties of the BK model in the continuum limit for the simplest case of the one-dimensional short-range model, in order to examine how the statistical properties of the discrete BK model changes or does not change in the continuum limit.

Finally, we discuss possible implications of the results obtained on the basis of the BK model to real seismicity.