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Understanding earthquake source dynamics is an important challenging problem in seismology. Earthquake faulting is mainly controlled by multi-scales dissipation processes within the fault interface, and by the geometry of pre-existing faults. Recent observations during the Denali and Izmit earthquakes have shed evidence for supershear propagation in relation with the fault geometry. Moreover generation of high frequency wave by seismic faulting is a long standing issue in seismology with important implications in terms of seismic engineering and seismik risk assessment. Numerical simulations of earthquake rupturing can bridge the gap between laboratory experiments and observations of large earthquakes. The simulations needs to capture the different space and time scales involved in the nucleation phase, the rutpure front propagation and the short wave radiation, owing to the fault heterogeneities and geometrical complexities. Numerical methods based on non smooth contact mechanics allow for efficient simulations of dynamic rupture along planar and non-planar faults. We shall present here recent progress in the mechanical and numerical modelling of dynamic earthquake rupturing and of the associated short wave radiation in seismology. In conclusion, some of the mechanical and numerical challenges will be discussed.