Fog related crashes continue to be one of the most serious traffic safety problems in Florida. Based on the historical crash data, we found that single vehicle crashes have the highest severity among all types of crashes under fog conditions. In this thesis, we first analyzed the contributing factors of the fog-related single vehicle crashes (off road/rollover/other single) severity in Florida from 2011 to 2014 using association rules mining. The results show that the lane departure, distracted driving, wet road surface and dark without road light are the main contributing factors to severe fog-related single vehicle crashes. Some suggested countermeasures were also provided to reduce the risk of fog-related single vehicle crashes. We further analyzed the crash reports based on text mining technique. Topic modeling was also employed to discover important topics in crash narratives. A lane departure warning system under connected vehicle system was tested in driving simulation experiments. The results show our warning system is efficient in specific circumstances.