Development of the mobile 3D seismicity viewer

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It is widely known that Japanese Islands are located at the subduction zone of the Pacific and Philippine Sea plates and a number of earthquakes occur due to the subduction. Seismicity distribution is neither simple nor uniform; however, earthquakes intricately occur around Japan. Also, the shape of the subducting plate is complex. We usually plot the 2D map and vertical cross-sections to investigate the seismicity at a certain region. It is not easy to understand the 3D distribution from 2D images. Therefore, we develop the mobile application to show the 3D seismicity distribution with the subducting plates and topography in order to help non-professional understand where earthquakes occur around Japan.

We target the iPhone and iPad for the readily and intuitive user interfaces rather than that of the PC. By using the graphics API distributed in 2014, we can expect the high GPU performance of the 3D graphics on iOS. We use the Swift programing language and SceneKit framework used for 3D game applications. We use the Hi-net hypocenter catalogue on September 2015 as a sample data.

First, the hypocenter catalogues saved in the device is loaded. We can specify the ranges of the magnitude and depth. Spherical objects whose size and color corresponds to the magnitude and the depth are created and located at the position calculated by the latitude, longitude and depth information of the earthquake. The shapes of the subducting plates are described by triangular net which calculated by using the “triangular” command of the GMT and saved on the device as the COLLADA format. The shape of the topography based on the ETOPO1 is also saved on the device. The user can choose the color image corresponds to the height of the topography or coastline image as the texture image of the topography object. The displayed 3D seismicity distribution can be rotated, scaled and moved by swipe actions. Each spherical object has the information of the hypocenter such as the occurrence time, depth and magnitude. That information can be displayed by tapping the object.

We investigate the frame rate as the performance of the application. The frame rate indicates the smoothness of the motion of the application and is the number of the drawing per second (fps). This time we check the fps on the iPhone 6 and the iPad Air. When we plot 1-day seismicity (450 earthquakes), the frame rates are (iPhone, iPad) = (60, 45) fps. With these high frame rates, we can smoothly move the 3D objects without any stress. For 1-week (3200 earthquakes) and 1-month (12800 earthquakes) seismicity distributions, the frame rates are (30, 18) fps and (11, 5) fps, respectively. All of the functions work without error for the 5fps, but the motion becomes jumpy.

In this presentation, we use the sample hypocenter catalogue. In the future we imprement the download system of the JMA unified earthquake catalogue through the Hi-net website.

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