Radar Polar Region Research on Earth, Venus, Saturn, Jupiter and Their Moons. L. Feng [1], C. Deng [2], Y.Li [3], M.Li [4] and J.-P. Muller [1], [1] Mullard Space Science Laboratory (MSSL), University College London, Department of Space & Climate Physics, Holmbury St Mary, Surrey, RH5 6NT, United Kingdom, lang.feng.14@ucl.ac.uk, j.muller@ucl.ac.uk, [2] Information Engineering University ,Zhengzhou 450001, China, [3] Key Laboratory for Aerial Remote Sensing Technology of National Administration of Surverying, Mapping and Geoinformation (NASG) & Chinese Academy of Surveying and Mapping(CASM) , China, [4] National Geomatics Center of China(NGCC) , China.

Abstract: Radar (radio detection and ranging) is currently one of the important research areas for Earth and moon observation and for helping human being explore and detect the organics and life in planets and their ICE moons, many radar satellites have been or are about to be launched, such as Magellan (1994) radar for Venus ,Cassini (1997) RADAR instrument for Saturn and its moons, Mars Reconnaissance Orbiter (2005) Shallow Radar (SHARAD) sounder and Mars Express (2005) Mars Advanced Radar for Subsurface and Ionosphere Sounding (MARSIS) for Mars, Lunar Reconnaissance Orbiter (LRO 2009) Miniature Radio Frequency (Mini-RF) for Earth's moon and in the near future JUICE mission [1] (RIME - Radar for Icy Moons Exploration, SWI - Sub-millimeter Wave Instrument, RPWI - Radio & Plasma Wave Investigation, 3GM radio science package - Gravity & Geophysics of Jupiter and Galilean Moons) for Jupiter and its moons. The Magellan multimode S band radar has three modes: SAR, altimetry, and passive radiometry to map almost all of the Venusian surface, while the Cassini RADAR instrument transmits and receives Ku-band microwave radiation, which operates in both passive (radiometer) and active (altimeter, SAR imaging, scatterometer) modes. Nowadays, Venera 15 and 16 radio occultation experiment data at Venus, Magellan stereo SAR data and Cassini RADAR data and Radio and Plasma Wave Science(RPWS) data are opened to public at PDS. Moreover, Lunar Reconnaissance Orbiter (LRO) Mini-RF data (S band and X band Raw data, Bistatic Radar data, Level 1 SAR, Level 1 interferometry, Level 2 SAR, Level 3 SAR mosaics, and Level 3 Sandia SAR Stereo data [2]) are available at PDS too, which will greatly advance our understanding of our moon, giving us the first look inside the Moon's coldest, permanently shadowed darkest polar craters with water ice [3].

Our work is primarily concerned with generation digital topographic models (DTMs) by using Magellan stereo SAR, Cassini RADAR data and LRO Mini-RF images (Stereo and InSAR) via radargrammetry and InSAR. Stereo images and metadata are prepared in ISIS first. Then a rigorous sensor model is developed. After coregistering the radar images as closely as possible to one another, Bundle adjustment will be implemented for DTM production. Besides, fast and automatic DTM coregistration with DTM will be studied for finding the correct and precise planned location for safe planetary rover landing. on many terrestrial planet and its moons with magnetosphere and atmosphere, Solar wind and EUV radiation creates ions in the upper atmosphere as plasma ionosphere. Now, Radar (radio wave) observations is an important technique for Characteristics of ionospheric electron density profiles in the ordinary, auroral and polar cap regions. Our study will focus on ionospheric electron density and ionospheric tomography using radio occultation data and Radio and Plasma Wave data on Earth, Venus, Titan and Saturn. Then, with the help of DTM (DEM) and ionospheric electron density profiles in cryosphere ice investigations, 3D tomographic SAR imaging (SAR tomography) is derived from data stacks of L band ALOS PALSAR data stacks and L band and P band IceSAR data in Greenland on EARTH and LRO Mini-RF S-band and X-band circular polarization data on earth moon's polar region to obtain the number of scatterers inside each pixel, the scattering amplitude and phase of each scatterer and finally extract 3D ice internal positions, ice surface & subsurface ice structure & 3D tomographic profile and ice displacement motion parameters. All methods will be prepared for future JUICE mission for Jupiter and its ice moons (like lo, Europa, Ganymede, Callisto and so on). Previous and latest research results will be shown.

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