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Sonic Anemometry of Planetary Atmospheres

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Sonic anemometers present some advantages compared to other technologies such as cup anemometers, propeller or hotwire anemometers [Wyndgaard, 1981; Cervenca, 1992]. First, sonic anemometers are able to measure the complete wind speed vector, whereas other technologies need to use three sensors or even they do not present such possibility. Second, sonic anemometers are especially robust and are the only type of sensors that simply requires an initial calibration, which means a clear advantage in harmful environments like the atmosphere. Finally, sonic anemometers can reach useful sampling rates in the order of 100 Hz, quite larger than the corresponding to cup anemometers [Cuerva and Sanz-Andr&#65533;s, 1999] and present the possibility of measuring sound virtual temperature [Nielsen and Larsen, 2002; Larsen, Edson et al, 1993].

All these characteristics make sonic anemometers to be ideal candidates for atmospheric application. Since sonic anemometers have not moving parts and can be designed to have loss mass and power consumption they have become adequate for planetary exploration purposes both for atmosphere studies and for flying robots control [Genese and Barnes, 2001].

Although, traditionally, sonic anemometers have been considered as absolute sensors (able to work independently from the type of fluid) [Kaimal et al., 1968], recent developments on the theory of sonic anemometry have allowed to establish corrections in the measure of wind speed, temperature and their derived parameters which are flow/fluid dependent [Cuerva and Sanz-Andr&#65533;s, 2000, 2002; Cuerva, 2001]. This fact has opened the possibilities of optimisation of sonic anemometry for its application in different planetary atmospheres.

Important differences between the behaviour of these sensors for the same averaged wind speed in the three considered atmospheres of Mars, Jupiter and Earth are detected in terms of characteristics of turbulence measurement as well as in terms of optimum values of anemometer design parameters for application on the different considered planetary atmospheres.