



Identifiant de la contribution : 254

Type : non spécifié

”SIGPRO#5 - Design considerations for smartphone camera-based rotational speed measurement”

mardi 11 juillet 2023 12:00 (20)

“Condition monitoring of rotating machinery gains importance in order to optimally schedule maintenance and to guarantee operation safety and production efficiency. Varying speed conditions are common in rotating machinery operations, but pose a challenge for vibration analysis. Nevertheless, a direct measurement or an indirect estimation of the rotational speed can simplify the monitoring process. Recent studies have shown that a smartphone’s low-cost camera can serve as a rotational speed measurement tool, even though it has a low frame rate, by exploiting the rolling shutter effect. In rolling shutter cameras the pixel lines of an image are not sampled simultaneously, but sequentially at a sample rate that is much higher than the frame rate. This rolling shutter frequency results in a very high Nyquist limit allowing for the measurement of high rotational speeds.

A recent study proposed a theory and the corresponding methodology to measure the rotational speed of a shaft using a smartphone’s rolling shutter camera pointed towards the curved surface of the shaft around which a wide zebra tape was glued. Due to the rolling shutter effect, the stripes are captured as inclined lines of which the angle depends on the rotational speed. The goal of this paper is to investigate and validate the influence of various design parameters, e.g. the dimensions of the zebra tape, on the rotational speed measurement. The design considerations are applied on an in-house experimental drivetrain running at shaft speeds in the range from 5 to 50 revolutions per second and their effect is evaluated in order to conclude with general design rules for smartphone camera-based rotational speed measurement.”

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Classification par session : Survishno 3 / Signal Processing