Deformation Measurement System for Buckling Tests on Continuously Transposed Cable using a High-Speed Camera

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Abstract

A high-speed camera based tracking system for deformation measurements of CTCs during short-circuit tests has been developed. For that purpose optical markers are fixed on the Continuously Transposed Cable (CTC) under test and a motion tracking software is used to evaluate marker movements during the short circuit test from the camera recordings. Fig. 1 shows a top view onto the three inner and outer CTC turns of the test setup between two sticks. The inner turns will be pressed against the core (+y-direction) while the outer turns are stretched in –y-direction.

The new system has been successfully verified by another measurement system based on acceleration sensors. The deviation between both systems is about 10 %, even for small deflections of 100 μm. In comparison to the acceleration sensors the tracking system has the advantage to recognize persistent deflections which are an important indicator for plastic CTC deformation and the beginning of buckling.

The practical application of the measurement system has been shown with an investigation of the influence of the paper insulation on the CTC stiffness. Two CTC segments - one with and the other without paper covering – have been tested in parallel so that each part is exposed to the same electromagnetic force. Short circuit testing current has been increased step by step, until a significant buckling occurs. In Fig. 2 the radial peak deflection of the inner CTC turns and the persistent deflections after each test are shown. The red curves from the CTC segment with paper covering show lower peak deflections compared to the segment without paper covering and also the beginning of persistent deformation is at much higher loads. For the CTC under test, the paper covering leads to an increase of linear stiffness by a factor of 2.2 as result of paper insulation. The increase in critical buckling load has been estimated to 22.4 % if the paper covering is available.

References