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THE MODELLING OF THE DEGRADATION AND LIFETIME ESTIMATION FOR THE GEO SATELLITES SURFACE MATERIAL BY ITS PHOTOMETRIC OBSERVATIONS AND LABORATORY DATA

Abstract

A newly launched spacecraft photometric qualities differ from the ones that have spent some time in orbit. Particularly in the Geostationary orbit where the space weather radiation makes a significant contribution to the surface degradation of the spacecraft parts. Plus, the micro- or nano-collisions with space debris particles as small as a millimetre in size or less can be a factor in solar panel degradation and make its surface inoperable earlier than it was designed. To make a proper prediction for the influences of the space environment (micro-collisions, space weather, etc) on the spacecraft and give an estimate lifetime prediction an approach using optical observational data combined with laboratory and computer modelling have been developed. First, by modelling the common shapes of the spacecraft and its light curve analysis, which are accompanied by the surface material layering. Later the laboratory experiment constructed with the optical bench, where we found the different types of the light curve reflected from the known surface material by multicolour photometry and colour indexes (B-V) and (V-R) reflecting a different part of the satellite and material commonly used in the construction of the spacecraft. The variation of colour indexes with time provide us with information about the rate of surface degradation. Moreover, each part of a satellite has a different surface composition degradation rate. This knowledge may provide us with valuable information about the functionality of the satellite. It was shown in previous works that this information is especially important in the first three years after the launch. In this work, we present the modelling of a certain shape of the spacecraft and its reflecting abilities and its surface analysis methodology, which will further be tested on the surface degradation evaluation based on multicolour photometric observation of Kazakhstan's satellites KazSat-2 and KazSat-3.