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Combination of the SRC images and radio-tracking data of Mars Express for improving the Phobos' gravity field determination from close flyby(s).

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The determination of the gravity field of Phobos up to second-order terms is the main objective of future close flybys of the Martian moon by Mars Express (MEX). Such flybys at close distance (typically less than 60 km from the center) are needed to obtain the signature of the second-degree coefficients of the gravity field of the moon in the spacecraft orbit. However, a major issue is that a precise knowledge of the position of Phobos at the time of each flyby is critical in order to avoid significant biases on the retrieval of the gravity field coefficients from the reconstruction of the MEX orbit. In order to overcome this problem, we have proposed in the frame of the European FP7 ESPaCE network the idea to perform a series of astrometric measurements of Phobos around the Mars Express flyby(s), with the Super-Resolution-Channel (SRC) of the HRSC camera onboard MEX. Based on these measurements, an improved ephemeris of Phobos' orbit specifically designed around the flyby is generated. Then, it can be used in a global inversion scheme with radio-tracking data of the spacecraft acquired during and around the flyby, in order to obtain a very precise and accurate solution of the gravity field of Phobos. In this study, we present this innovative methodology that may be used for future Mars Express flybys. Numerical simulations are run to quantify the error on the determination of the gravity field as a function of the uncertainty on its orbit. A strategy to optimize the use of the SRC operation is also developed.