Optimal Rendezvous in Near-Circular Orbits

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The present paper states comprehensive numerical-analytical theory of optimal rendezvous in near-circular orbits. The theory has been created for many

years, its basic components being of wide use in Keldysh Institute of Applied Mathematics, Russian Academy of Science for the flight control execution

of piloted and automatic spacecraft launches. In developing the theory all most typical practical tasks were considered: 1. Optimal free time transfers between coplanar and non-coplanar orbits.

2. Rendezvous in coplanar orbits (3 variants of optimal solutions). 3. Optimal rendezvous of spacecraft that initially were placed into non-coplanar orbits. 4. Rendezvous with the limitation on the altitude of drift orbit. 5. Choosing of the maneuvering scheme (number of impulses etc.) that admits of reducing influence of thruster performance errors and errors of initial determination of orbital elements on the total fuel consumption. 6. Choosing of the maneuvering scheme (revolution numbers for chaser and target spacecraft, etc) allowing optimal rendezvous with considerable initial difference of ascending nodes of the orbits. Simple numerical-analytical algorithms used to solve all these tasks provide instant solution which is represented graphically. The specified accuracy of building-up the sheduled orbit with regard to all disturbing factors (e.g. non-spherical gravitational field, atmosphere, shut-down impulse etc.) is ensured by the application of the iterative procedure which may use both numerical and numerical-analitical integration. There is also graphical interaction with the task to comply with some additional limitations. Advantages of proposed methodes are well shown in solving of the rendezvous problem considered by the NASA group in their work on the Mars 2002/2005 Sample Return Mission.