

ASTRODYNAMICS SYMPOSIUM (C1)  
Orbital Dynamics - Part 1 (3)

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ANALYTICAL SOLUTIONS OF THE RELATIVE MOTION ABOUT A KEPLERIAN ELLIPTIC  
ORBIT**Abstract**

The purpose of this paper is to obtain a third-order expression, in the in-plane and out-of-plane amplitudes, of the solutions of the elliptic Hill-Clohessy-Wiltshire non-linear equations. The coefficients of the 3rd-order expansions of the coordinates are given as explicit functions of the eccentricity  $e$  of the orbit of the leader. For  $e = 0$  we recover the solution given by Richardson and Mitchell for the circular case; for  $e$  different from zero, the linear terms of the solution recover the solution found by Lawden for the linearised elliptic HCW equations, also known as the Tschauer-Hempel equations. In the last part of the paper we explain the how a formal series solution of the elliptic HCW non-linear equations (in powers of the two amplitudes and the eccentricity) can be obtained, using the Lindstedt-Poincaré procedure.