# List of Models of Interest

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* CR3BP [D. V. Pinto]
* CR3BP in the Vicinity of the secondary (Hill’s Problem) [D. V. Pinto]
* ER3BP [D. V. Pinto]
* ER3BP in the Vicinity of the Secondary (Elliptic Hill’s Problem) [D. V. Pinto]
* BR3BP [D. V. Pinto] , [Boudad]

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# Matlab Things To Do

* Hill?
* Sun Bicircular Flavour Where Earth and Moon are inclined and the x axis is the Sun-Earth barycenter (for instsance, in this case, the halo orbits of the Earth don’t exist anymore… only “perturbed halo orbits of the EM barycenter” will exist, where the perturbation is given by the fact that the Earth and Moon are rotating and thus, sometimes they get closer to the “liibration point of the barycenter”)
* Implement the “true model” = ephemerides model in MATLAB
* Hill 4 body elliptical
* Implementing Omega from eclipses data? (For the bicircular)
* For the comparison between CR3BP and Bicircular, it might be interesting to compare how the absolute value of the differences between the two models (for example in x,y,z) changes with the distance of the 4th body to the Sun. Implement it!
* Edit bfbpv.m function so as to accept the bfbpv vector field.
* Try to write the Howell’s algorithm to find Halo orbits?
* Function spice\_to\_rtbp: maybe add option to get final coordinates in rtbp synodic or rtbp inertial reference frame.
* So far, spice to rtbp only converts spatial coordinates, leaving the velocities unchanged. Take care of this next

# Ideas to be probed

Relativistic effects?

Solar Radiation pressure?

Around small bodies?

Geopotential perturbation?

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# Towards and Index…

Questions to be addressed could be, for instance:

When do we switch from CR3BP to ER3BP? We should be able to define an

index (perhaps function of the eccentricity and some other parameter).

When this index reaches a given threshold, it’s time to switch to the ER3BP

model. This of course must be decided by means of simulations.

Another way could be: we define an index, and we compute it for different

cases both in the case of CR3BP and ER3BP, and then we compare them. The

moment they start diverging by a given threshold, we abandon. The CR3BP

and we switch to ER3BP.

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**Metric IDEAS:**

Gomez and Masdemont use this metric and then compare their model based on Fourier analysis with the RTBP, BCP, QBCP. Computing this value for two different models, they show that the model based on Fourier expansion describes the true problem (which is given by the JPL ephemerides for some halo orbits around a given collinear point) in a much better way than the mono-frequency approximations (such as R3BP or BCP, QBCP) do.

Please note that it is NOT always the case that the more frequencies are considered, the more descriptive the model. This is because sometimes, adding more frequencies does not add any information in the problem…

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***The question is: is this the simplest and more robust way of comparing two models? (for example, they mention in the text that another method (involving the computation of the Jacobi constant) was also used.***

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get\_n in different ways (for example average of T) or with orbital elements…***

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***Beware: since the function rv2cel computes the orbital elements in [L] units, if we have SUN-EM Barycenter, then OBSERVER = SSB***

***If we have Earth-Moon, then OBSERVER = EMB***

the ap\_as is needed in the HFEM! IDEA: maybe you can retrieve it numerically, adding it as an output to get\_ephemeris in the interpolators.

***Question: b4 coefficient: the “2 “position seems to be ambiguous: beom has it at denominator. Masdemont at numerator***

***Make sure that the times agree.***

***Make sure that the way the times are computed for etbp is correct***

***Understand if the n computation can be improved***

***Compute vector field on Halo Orbits***

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***The problem with the adimensional accelerations I get, is that rtbp and etbp have different time units. Since the accelerations I get for both are in the synodic, adimensional system, I need to use go\_inertial on the accelerations. However, the go\_inertial function I wrote, has “n” as input. This means I can only go from synodic-rtbp to inertial. Probably, in order to go from synodic-etbp to inertial, I just neeed to use avg\_nu\_dot in place of n in the go\_inertial function.***

***I saw that the (second) matrix term in the Beom park formulation is the one that really makes the difference between RTBP and ETBP, because it is the term containing the eccentricity. Therefore, since it multiplies the velocity of the spacecraft, in order to see its effect, we need to consider spacecrafts with states (x,y,0,vx,0,0) instead of (x,y,0,0,0,0)***

***The units of times are taking care of in the call HFEM(), HFEM\_etbp\_b\_coeff() and HFEM\_rtbp in the main.***

***The units lengths are adjusted in the HFEM\_etbp\_b\_coeff funcitons converting them in the rtbp unit legnths by means of the conversion factor r(t)/L at each iteration (at each time).***

***Kinda the same was done for HFEM, where the conversion factor is r\*(t)/L, where r\*(t) is computed via spice.***

***Please note that, on the other hand, since the spacecraft is evaluated in a grid, the points x\_spacecraft do not need conversion, because we compute them exactly on the wanted rtbp-like grid already.***

***Problem: Why do I get the primaries’ positions wrong in the HFEM?***

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PROBLEMS  
1) the stm computed numerically does not seem to work properly. For now, I am using the one computed via the vector field, but the vector field used is rtbpv, since I don’t have the HFEM\_rtbp version with the variational equations. FIX THIS***

***2) for now, the Single value decomposition problem is applied so as to make sure that M is non singular, but probably I will need to do Cholewsky***

***3) in any case, the corrections don’t seem to work properly. Perhaps rewrite the code or ask Ruilong.***