Time-Independent Lambert's Problem (TILP)

Time dependent version is given 2 positions and time between them, calculate transfer orbit.

Results in Lambert's theorem

TILP is given initial position and additional piece of information, in this case the true anomaly of the initial transfer arc, find TOF or total ΔV (if given initial velocities)

Algorithm:

Given: $\bar{r}_1$, $\bar{r}_2$, $\theta^*_{T_1}$

Find: TOF

1. Determine transfer angle (TA)

2. Find minimum eccentricity, emin

e_{min} =

3. Find transfer orbit characteristics

e_T =

where ξ =

P_T =

a_T =

4. Find corresponding eccentric anomalies to find TOF.

If you want to find ΔV_{TOTAL}, must know original orbits, and if the orbits are coplanar, use vector diagrams to find ΔV_{TOTAL}.

Otherwise, must be given $\bar{V}_1$ and $\bar{V}_2$ of orginal orbits and

1.

2.

3

To minimize Δv, vary θ^*_{T1} - where

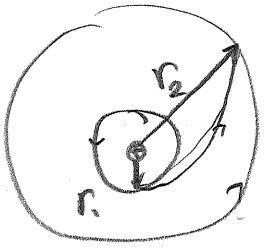
Example: Shuttlecraft to USS Enterprise.

$r_1 = 1.25\, R_\oplus$ circular orbit

$r_2 = 4 R_\oplus$ circular orbit

$TA = 120°$

$\theta_D^* = 42.4°$



Find TOF and ΔV.

Start with finding transfer orbit: a_T & e_T

$e_{min} =$

$\xi =$

e_T =

P_t =

a_T =

To find TOF, need E_D and E_A.

E_D =

E_A =

Then

TOF =

Now find ΔV_1 and ΔV_2.

Before departure:

After maneuver

Vector diagram

Before arrival

After maneuver

Vector diagram

Hohmann transfer: