1.

a)

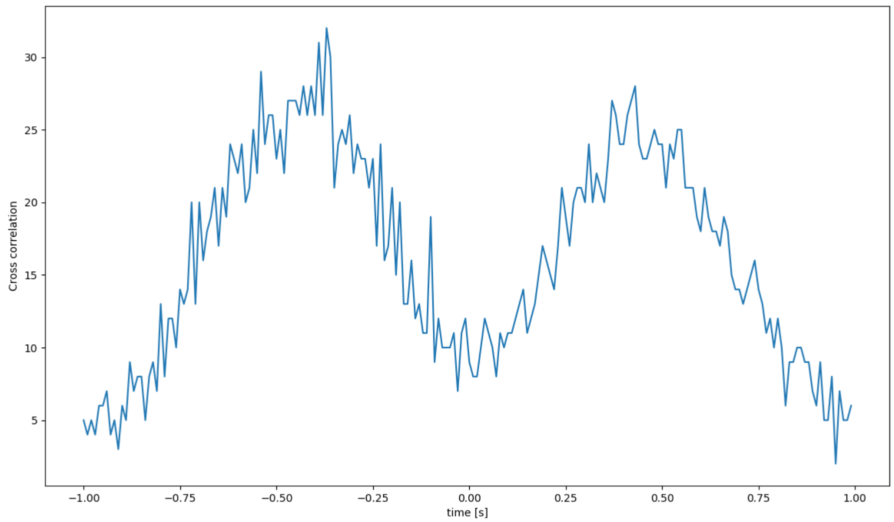

Abbildung 1: Cross correlation function of r_1 and r_2 for $\omega = \pi$.

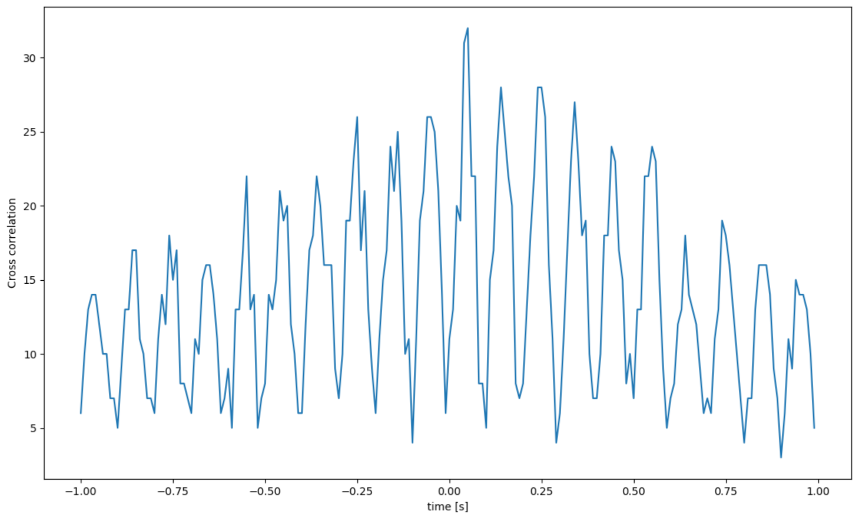

Abbildung 2: Cross correlation function of r_1 and r_2 for $\omega = 10\pi$.

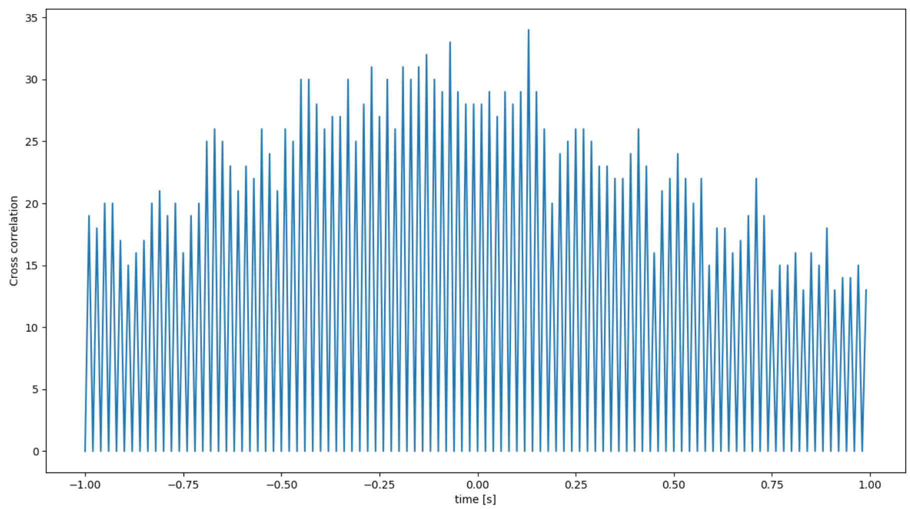

Abbildung 3: Cross correlation function of r_1 and r_2 for $\omega = 50\pi$.

Both, $sin(x)^2$ and $cos(x)^2$ are symmetric (with regards to $t = 0$) hence the cross correlation function has to be symmetric.
For $\omega >> r_0$ the frequency of the cross correlation function increases until it cannot be distinguished from $c(t) = 0$.

b)

Choosing $r_3(t) = r_0 * cos(\omega * (t - 0.3))^2$ (the function in a) has a peak at $0.5s$, so moving r_2 $0.3s$ to the right gives the desired result) gives a peak at $t = 200ms$:

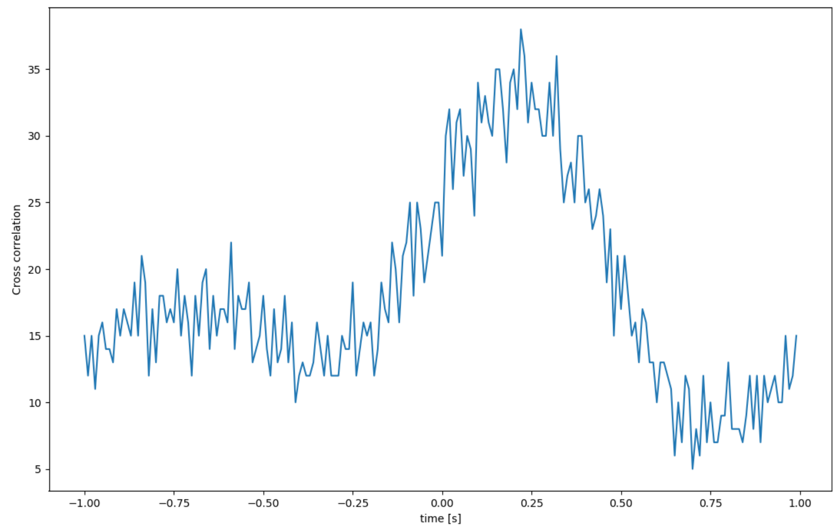

Abbildung 4: Cross correlation function of r_1 and r_3 for $\omega = \pi$.

2.

a)

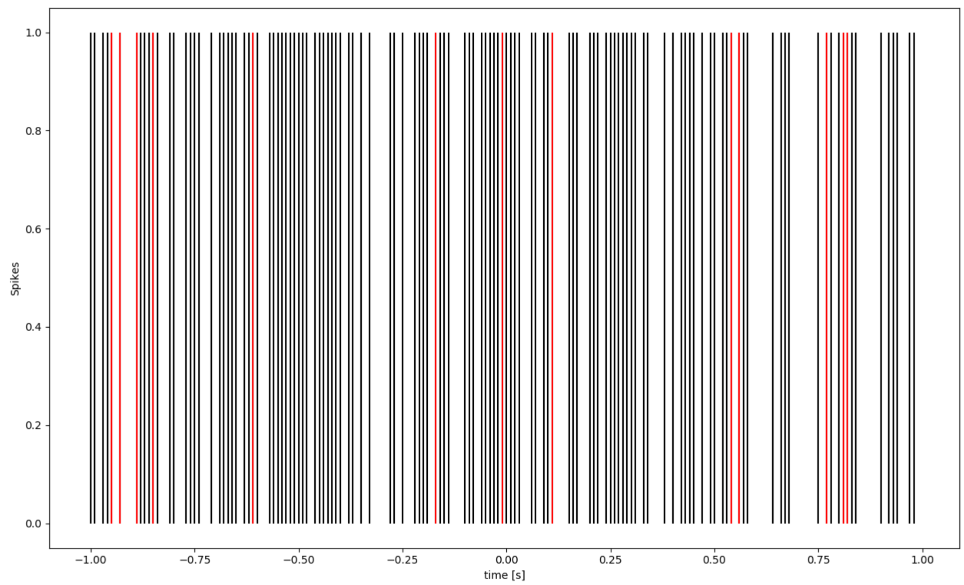

Abbildung 5: A parent train with frequency 60Hz (in black) and its child train (in red) with $p = 0.1$.

The rate of the child train is given by $r_{parent} * p$.

b)

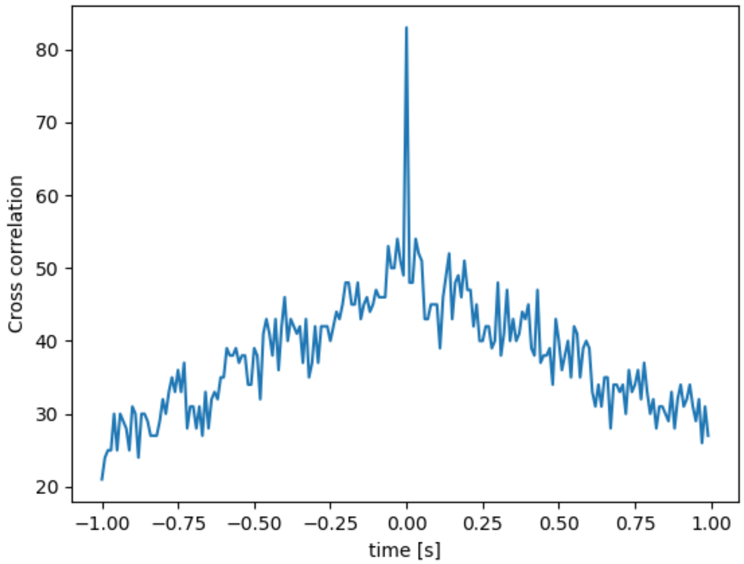

Abbildung 6: Cross correlation function with $p = 0.7$ and no jitter.

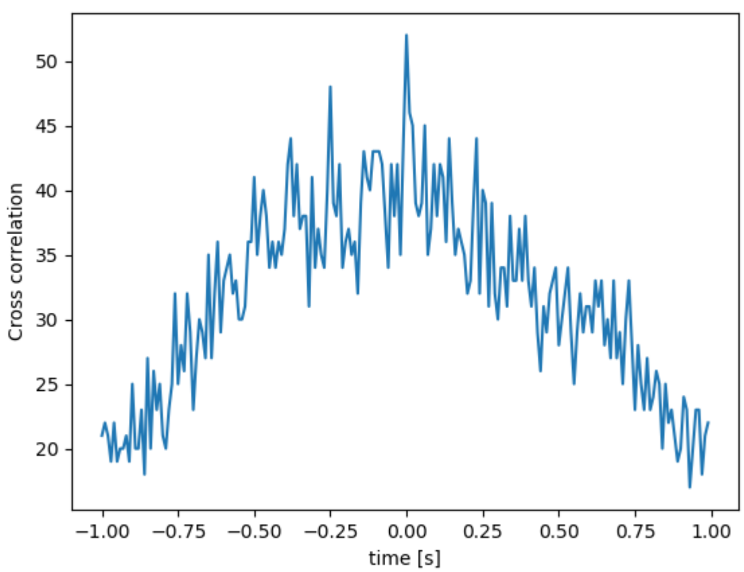

Abbildung 7: Cross correlation function with $p = 0.7$ and $\sigma^2 = 0.02s, \mu = 0s$.

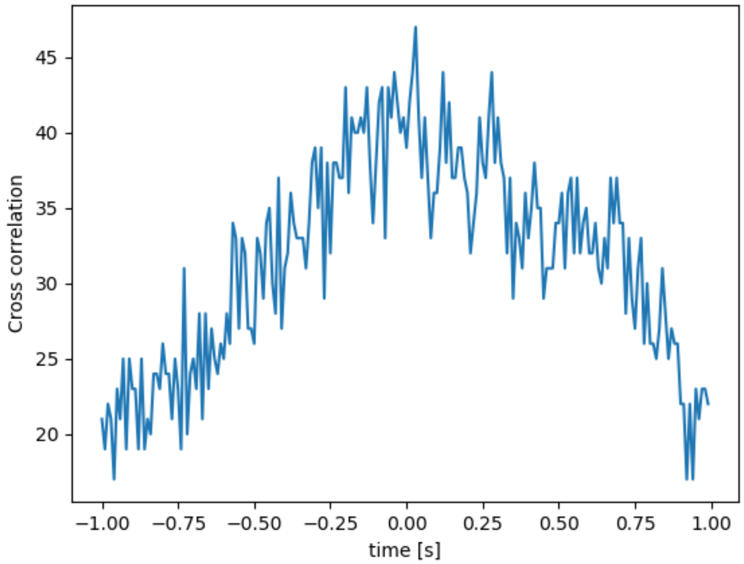

Abbildung 8: Cross correlation function with $p = 0.7$ and $\sigma^2 = 0.5s, \mu = 0s$.

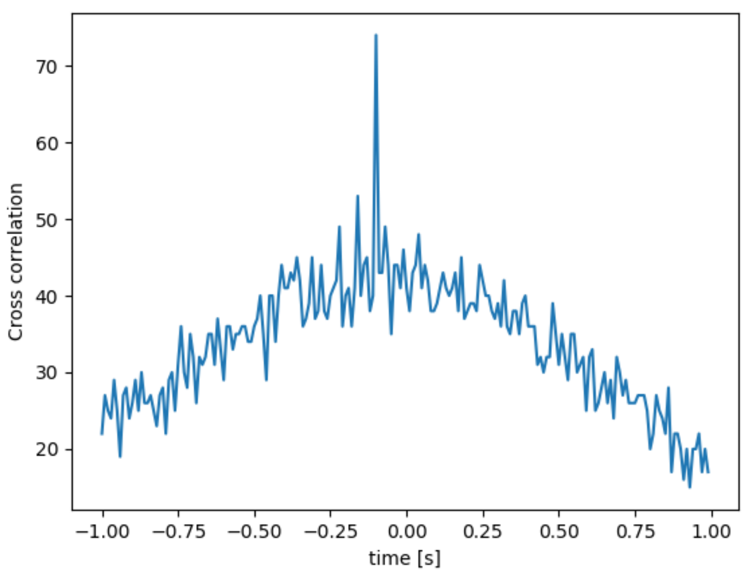

Abbildung 9: Cross correlation function with $p = 0.7$ and $\sigma^2 = 0s, \mu = 0.10s$.

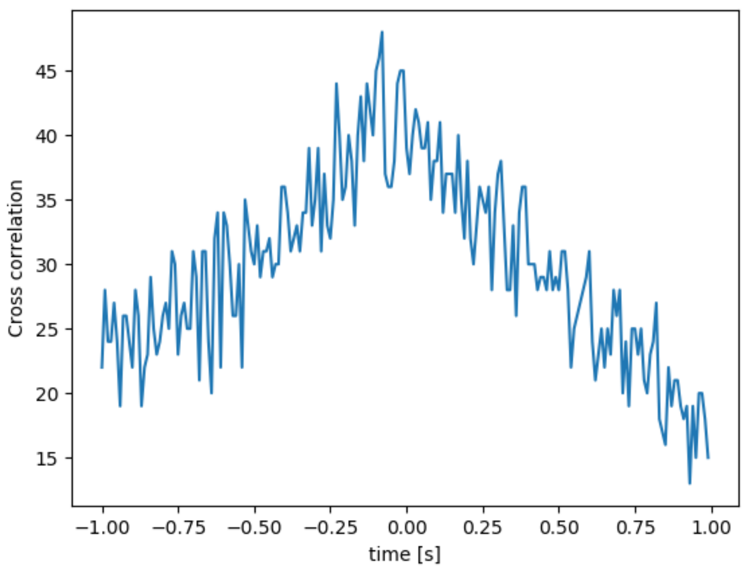

Abbildung 10: Cross correlation function with $p = 0.7$ and $\sigma^2 = 0.02s, \mu = 0.10s$.

c)

If we choose similar to the $\sigma^2 = 0s, \mu = 0.10s$ case in a) μ to be $-0.2s$ we can move the peak to the right:

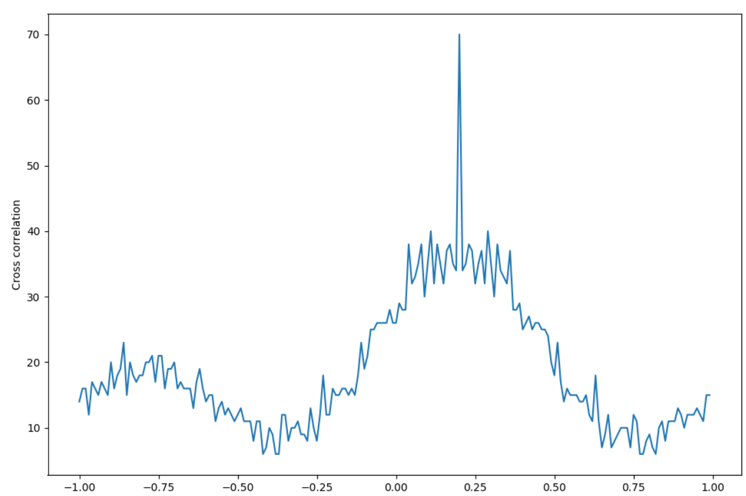

Abbildung 11: Cross correlation function of r_1 with $p = 0.5$ and $\sigma^2 = 0s, \mu = -0.2s$.

Increasing ω has the same effect as in 1c):

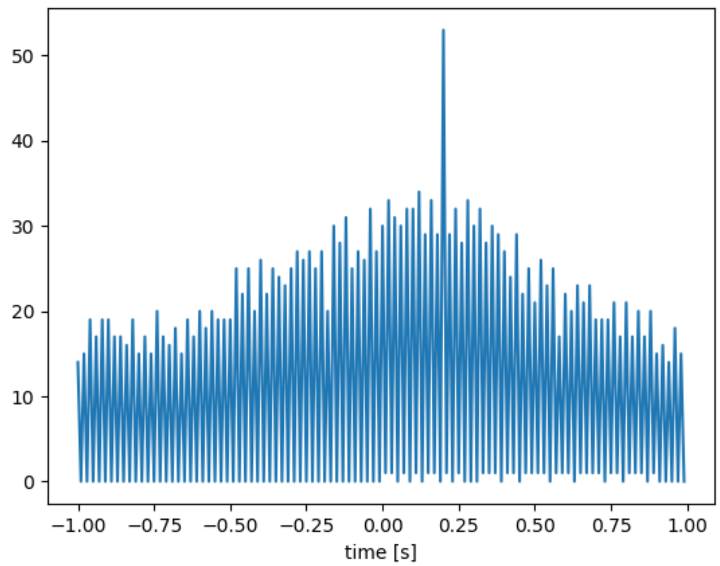

Abbildung 12: Cross correlation function of r_1 with $p = 0.5$, $\sigma^2 = 0s, \mu = -0.2s$ and $\omega = 50\pi$.