Velociraptors Problem

There are n raptors who try to catch and eat you. All the raptors always run directly toward you. There is a safe zone for you. The goal of the problem is to find a path to the safe zone without getting caught by a raptor. You and the raptors have fixed speed, V_y and V_{r_i} respectively, where r_i stands for the i-th raptor. You are located in the interior of rectangular domain $\Omega = [-w, -h] \times [w, h]$. The safe zone is the area beyond the upper boundary line, that is, the segment between two points, $(-w, h)$ and (w, h).

You have to formulate optimization problem and solve for it. There are many ways of converting this problem to a finite dimensional optimization problem. It is not too critical which one you choose. However, there are problems where the formulation is critical. From past projects the hanging chain problem was one such problem.

You are free to choose any problem set of raptors you like. However, it is recommended to start with a simple one first. Below is an example that is not so simple. Interesting problems are ones in which the path the prey takes is unusual.

An example problem

There are four raptors. The domain is $\Omega = [-60, -30] \times [60, 30]$, the initial positions of the raptors are

$$P_{r_1}^{(0)} = (-60, 30), P_{r_2}^{(0)} = (60, 30), P_{r_3}^{(0)} = (-30, 15), P_{r_4}^{(0)} = (30, 15),$$

and $V_y = 8\ m/s$, $V_{r_1} = 13\ m/s$, $V_{r_2} = 8\ m/s$, $V_{r_3} = 10\ m/s$, $V_{r_4} = 8\ m/s$. The Prey (you) are at (0,0) and you can run at 8 m/s.