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Hands–on exercise

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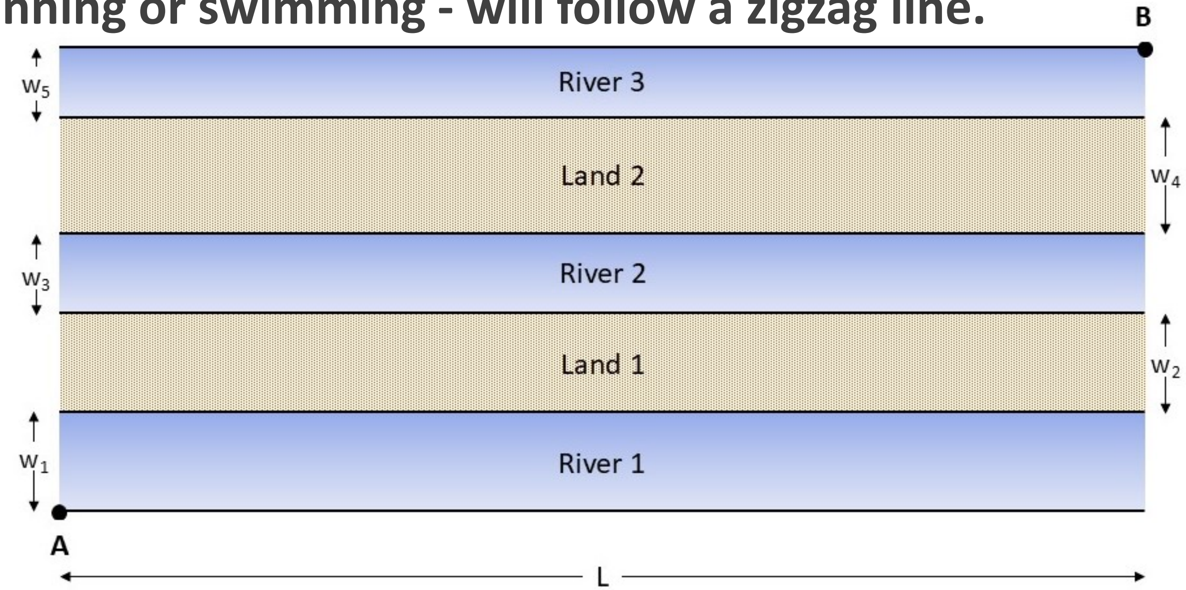
Notes available at

147.102.55.162/kgianna/optdpms/notesw.html

The ‘problem’

- ✓ The following figure (not to scale) presents a map of a region with three rivers (River1, River2, River3) and two intermediate strips of land (Land1, Land2). All lines are horizontal.
- ✓ Assume an activity that combines running (on Land1 and Land2) and swimming (in River1, River2, River3), starting from point A and finishing at point B. On land (Land1, Land2), you run at a speed V (m/s). In the water, you swim at speed V/3 in River1, at V/2 in River2, and at V/5 n River3.
- ✓ The horizontal distance L between A and B is L=500m. The vertical widths are w_1=11m, w_2=9m, w_3=20m, w_4=23m, w_5=5m.
- ✓ The motion - whether running or swimming - will follow a zigzag line.



Hands – On Exercises

1. Set the design variables and their bounds. Recall that wide bounds will result in slow convergence, while very narrow ones may prevent you from finding the optimal solution.
2. Solve a SOO problem to compute the route that allows you to finish in the minimum possible time. Use a standard EA, test and compare various search schemes, such as different sets of values for (μ,λ), different encoding, mutation operators, crossover operators, etc. In one of the examined cases, compare the effect of the EA initialisation, i.e. use of the random number generator (RNG). All optimisation runs should not exceed 1500 evaluations. Comment on the results. Which scheme performs better?
3. Solve the same problem using the Metamodel-Assisted Evolutionary Algorithm (MAEA). Perform any relevant parametric studies. Measure the gain in terms of the number of required evaluations, etc.?
4. Solve a constrained SOO problem (with or without surrogates). The constraint is that no swimming segment may form an angle greater than ϕ-5^o with the horizontal axis. Angle ϕ is the smallest of the three angles of the optimal solution computed in (2). This way, the optimal solutions computed before do not satisfy the constraint.
5. Solve a MOO problem aiming at minimising the route length and the time required to finish it. Plot the Pareto front. Perform any relevant parametric study (indicatively, compare SPEA vs. NSGA, use MAEA, etc.) and comment on the conclusions.

A way to solve the problem

1. **For the five (5) vertical zones (with widths w_1 … w_5) define the corresponding velocities.**
2. **Assume four (4) design variables, as shown below which define five (5) horizontal segments..**
3. **Loop on all zones, compute the distance and time required to cross each zone; sum distances and times to compute the objectives. Also compute the angles of all swimming segments for the constraint optimization problem.**