Multi Agent Path Finding - notes

https://cgshop.ibr.cs.tu-bs.de/competition/cg-shop-2021/#problem-description

Objectives

Makespan (M)

need to optimise slowest bot

Total work (TW)

everyone costs as much
optimal solution moves one bot at a time

Axes

axes are efficient. highway = oriented axis
they are useful to 2x more bots than "staircase" paths
M: highways for going in either direction?
TW: one line is enough, easy to avoid blocking it

these axes can also be learned
construct them by looking at the paths going through it
incentivise paths to go through it

Clusters and Dead ends

start: innermost have to start after
targets: innermost have to arrive first

Swans (M)

same motion of a cluster of bots
formation : internal rearrangement
harder to manage than individual bots

Waiting

M can move to liberate axis
TW better stay on the optimal path, but if necessary one can move out for the other to pass

Precedence graph (strict ordering)

we can use this graph to avoid blocking other paths, by knowing the order of some events

if we have a mapping src to dst for each robot
can be constructed from connected components in graph with edges (src,dst)
the graph contains simple paths and cycles

Priorities (soft ordering)

easier to manage bots in low density regions and close to borders
it is better to consider "deepest" position first

Freedom

the given grids are very dense
we need to balance highways and resting places

Constraints and Temporality

we can forbid bots the access to a square while someone else is on it
or make them pay if some robots will be there in the future

Randomness

good for breaking ties

Packing

need to check that the density of the target formation
is big enough to avoid taking too much space

(my) Solution

we map both starts and targets to a storage configuration
we transform storage1 into storage2

snapping to storage

start from the center and find a nearby free spot

storage transformation

create highways for bots to move along
having rectangles of width 2 allows for easy entering and exiting
longer rectangles to approch density of ⅔

what is missing

policies for resolving conflicts and moves prioritization
who can push, who has to retreat

dynamic rerouting
finding free routes

panic mode
spreading out clusters, freeing dead ends