Modular Design of Fuzzy Controller Integrating Deliberative and Reactive Strategies

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Abstract

This work presents the concept and realisation of the integration of deliberative and reactive strategies for controlling mobile robot systems. Programming at the task-level in a partially-known environment is divided into two consecutive steps: subgoal planning and subgoal-guided plan execution. A modular fuzzy control scheme is proposed, which allows independent development and flexible integration of different rule bases, each for fulfilling a certain subtask. The design process of the fuzzy controller is demonstrated with the examples of three rule bases.

1 Introduction

This work aims at integrating sensing, planning and control so that the coupling effects of these three components can be taken into account and then the performance of the whole system can be enhanced. Planning methods which are totally separated from the sensing and control procedures normally assume that the robot motion environment is completely known. A survey of path planning methods is given in [2]. Pure geometric path planning in known environments uses a deliberative strategy. The approaches following this strategy normally have to solve problems of space division/representation, searching and complexity analysis of planning algorithms. By contrast, the reactive strategy regards path planning as a local feedback control problem. The task of local motion control is to determine the motion parameters for driving all the actuators by evaluating the up-to-date sensor information as well as a predescribed path.

If we compare the deliberative strategy with the reactive one, the following conclusions can be drawn:

• While the advantage of the deliberative strategy mainly lies in the overview of the whole reachable space, the reactive strategy lends itself to taking

into account dynamic aspects of the environment and applying sensor data directly to determine the robot path.

• However, methods of the deliberative strategy must presuppose that a complete environment model is available. The main disadvantage of the reactive strategy is the so-called "dead-end" problem, because the robot does not possess the ability to read maps and thus behaves rather "shortsightedly".

Integration of deliberative and reactive strategies will contribute to the solution of robot motion control in a mixed environment with known and unknown objects. In most cases in the real world, the environment is partially-known. On the off-line modelling side, with the help of CAD data and by applying a sensor fusion procedure, static information can be acquired, which represents fixed objects like walls, tables, etc. On the on-line perception side, data from a sensory system provide the controller with dynamic feedback information for detecting slightly moved objects and for avoiding unknown objects like clutters, pedestrians and other robots. Therefore it becomes an interesting problem how to design a control scheme which can fully utilise on-line sensor feedback as well as a priori knowledge.

Beyond the classical control approaches, like potential field [1], "intelligent computing methods", like neural networks and fuzzy logic are increasingly applied in sensing, modelling and robot control. Our work employs the fuzzy control approach and the modular design methodology. Actually, the principle of fuzzy control is intrinsically modular: a rule base is generated by increasingly developing each single rule, which has linguistic interpretations and its own control function. The order of these rules does not make any difference, both during the controller design and the rule evaluation. If we regard a rule base for fulfilling a certain subtask as a separate module, it is easy to understand that different rule bases can be developed independently and then integrated for realising a high-level task like collision-free motion from a given pair of start and goal position. Fuzzy control is becoming gradually as a main approach of robot sensorbased control. Applications range from the purely reactive fuzzy controller, e.g. [5], to the mixture of "behaviours" like single-goal directness and reactive collision-avoidance, e.g. [3] and [6].

This paper is organised as follows: section 2 introduces subgoals and the basic idea of the modular fuzzy control scheme. Then, planning issues for mobile robot systems are discussed in section 3. Section 4 describes design and implementation of the fuzzy controller and its integration in a control algorithm for subgoal-guided motion. Section 5 gives some brief conclusions.

2 The Concept for Integration

Our idea of integrating these two control strategies lies mainly in generating a set of critical points as subgoals, then using them for globally guiding the robot motion and still leaving some freedom for the plan executor to react to uncertainties.

2.1 Introduction of Subgoals

For applications in a partially-known, dynamic environment, the plan executor does not need a detailed geometric path like an interpolated spline curve provided by a planner since some of the path positions may have to be modified anyway due to the unknown static and dynamic obstacles. What is most useful for the on-line motion control is a set of subgoals, e.g. where the robot has to change its direction relatively sharply in order to arrive the next subgoal position. The main differences between a subgoal and a final goal are as follows:

- Subgoals should be much easier to reach than a final goal;
- The robot should usually move continuously through a subgoal point while it should stop at a final point;
- A subgoal can be flexibly generated, assigned to the plan executor and abandoned if necessary;
- Subgoals need not be traversed exactly, while a final goal is assumed to be fixed and should be exactly reached.

2.2 Modular Fuzzy Control Scheme

Conventionally, a preplanned trajectory is executed by a feedback position controller, which uses the sample of the trajectory as the desired value and the internal position sensor as the real value. With such a controller the data from the external sensors for acquiring *en route* information cannot be integrated into the controller. To solve this problem, we propose the following control structure for realising subgoal-guided, sensor-based robot motions, Fig. 1.



Figure 1: Integration of subgoal planning and sensorbased plan execution based on fuzzy control

Two main rule bases for driving actuators are subgoal approaching (SA) and local collision-avoidance (LCA). Rule base SA is responsible for the smooth tracing of subgoal points. Rule base LCA should perform the subtask for avoiding unanticipated local collisions based on sensor data. In section 4, the ideas and design procedures of rule bases SA and LCA will be presented in more detail.

Parallel to the rule bases SA and LCA, further modules can be independently designed in the form of rule bases, each for a specified subtask, and be put into the knowledge base of the fuzzy controller. In multi-robot applications, the command of another robot, which arrives through a communication channel, can be viewed as an individual subtask and represented by a rule base. If human-robot interaction is desirable, the linguistic interference can be also defined, developed and then integrated into the knowledge base.

To resolve potential conflicts between the output values, coordinating the different rule bases becomes very important. Generally, criteria of such a coordination action are

• robot-specific, i.e. a robot controller can decide by itself the importance priority of each subtask and use it to modify the influence on the outputs of these rule bases correspondingly. • situation-dependent, i.e. the importance priorities of these subtasks are not static and cannot be preassigned; they are dynamically determined by the *situation evaluation*.

3 Subgoal Planning Issues

3.1 Planning with a Tangent-graph

The subgoal planning problem is simplified to a 2-D case by representing the robot as a disc with radius r. Since the dynamic characteristics of the environment make the exact computation of subgoals unnecessary, only a rather conservative approximation of the environment is employed. Obstacles are assumed to be described as polygons. They are enlarged by a constant distance r. The robot is then shrunk to its reference point. In this procedure, edges and sharp vertices of these polygons are extended by r and the intersection points are computed as the new vertices of the enlarged obstacles. After that, planning subgoals consists of finding a sequence of straight lines connecting the start and goal points with the shortest distance which do not intersect with the enlarged obstacles. This problem can be solved best by searching in a Tangent-graph (T-graph), a simplified V-graph, [4]. The number of arcs in a T-graph is considerably reduced by eliminating non-convex edges and nontangential lines from the corresponding V-graph. An example of a T-graph is shown in Fig. 2.



Figure 2: A T-Graph of enlarged obstacles

The A* algorithm is used to search for a global route in the T-graph since it can find the shortest path if such a path exists. The nodes of the shortest path from a start position S to a goal position G are a sequence of vertices of the enlarged obstacles. They are viewed as the subgoals for guiding the global direction of the robot motion and can be represented as a sequence $\langle Q_0, Q_1, \ldots, Q_m \rangle$.

3.2 A Mobile Robot System for Experiments

This concept has been implemented for a real mobile gripper system *Khepera*, Fig. 3. *Khepera* is of circular shape with a diameter of 52mm. Additional modules can be mounted on the top of *Khepera*, e.g. a gripper and a vision module. The environment is observed by eight IR sensors (six on the front and two on the back). *Khepera* uses a Motorola MC68331 microcontroller, whose instruction set is compatible with the well known MC68020. A RAM size of 128k is available for user programs.



Figure 3: A mobile robot gripper system for experiments

3.3 Planning Time

Theoretically, the overall computation complexity of the pre-calculation for constructing a T-graph is on the order of $O(n^2 \log n)$. In the case of the *Khep*era robot, by using highly optimised fixed point arithmetics instead floating point, *Khepera*, achieves nearly half the calculation speed of a SUN-workstation. The following table shows the time for the calculation of V-graph, T-graph and subgoals of three example environments:

| Polys/Edges | 4/33 | 3/13 | 1/4 |
|-------------------|-----------------------|---------|-------|
| init T-graph | 116 ms | 21 ms | 18 ms |
| construct V-graph | $16241 \mathrm{\ ms}$ | 591 ms | 22 ms |
| construct T-graph | 289 ms | 44 ms | 5 ms |
| Subgoal plan | 538 ms | 284 ms | 30 ms |

4 Design of a Fuzzy Controller for Plan-Execution

The modular fuzzy controller was developed with the *TIL Shell* of *Togai Infra Logic*. The local collision avoidance as well as the subgoal approaching were realised by fuzzy *if-then* rules.

4.1 Approach of Subgoals

For briefness, we introduce the following rule base SA for tracing the path to the next subgoal. It is required to pre-calculate the two input variables *shortest distance to path* and *angle of divergence*:

- d: The shortest distance between the robot and the path segment connecting the previous subgoal and the next one (in the following called *path* for short).
- a: The angular divergence between orientation of the path and the robot.

SA generates the following output variables:

- *Speed*: The speed of the robot.
- *Steer*: The steering angle, based on the current direction of movement.
- A typical fuzzy rule of this module looks like this:

IF (d IS n) AND (a IS z) THEN Speed IS high AND Steer IS $\mathbf p$

If the robot is located slightly to the left of the path, but its orientation is almost on the path, then it will steer slightly to the right by applying a high speed.

The 49 rules of subgoal approaching can be found in Appendix A. The implementation of this rule base for *Khepera* takes a computation time of 3 ms.

4.2 Local Collision Avoidance

Typically, for local collision avoidance we need to determine the value and change of five proximity sensors, e.g. infrared or ultrasonic sensors (left, half-left, front, half-right and right). The LCA rule base tries to avoid collisions with unknown or dynamic obstacles. By observing the current values and the change of the five proximity sensors LCA calculates the speed and steering angle, which is needed to avoid obstacles. The input variables are:

- *SL85*, *SL45*, *SLR0*, *SR45*, *SR85*: Current value of the proximity sensors (left, half-left, front, half-right, right).
- dSL85, dSL45, dSLR0, dSR45, dSR85: They represent the difference between the current and last sensor value.

LCA generates the same *Speed* and *Steer* output variables as SA. A rule set is listed in Appendix B.

4.3 Situation Evaluation

Situation evaluation generates two parameters: the importance priority K, the replanning selector Replan.

- K: Importance priority for the LCA rule base. Each specific situation has its importance priority assigned.
- *Replan*: Decides if a situation, which requires the path planning procedure to be invoked once again, is reached. That will be indicated by a high value in *Replan*.

A typical fuzzy rule of this module looks like this:

IF (SL85 IS high) AND (SL45 IS vl) AND (SLR0 IS vl) AND (SR45 IS vl) AND (SR85 IS vl) THEN K IS high AND Replan IS low

If the leftmost proximity sensor detects an obstacle, which is near and the other sensors detect no obstacle at all, then mainly perform obstacle avoidance. No replanning of the path is required.

The implementation of this rule base for *Khepera* takes a computation time of between 8 and 14 ms.

4.4 Coordinating LCA and SA

The coordination of the rule bases LCA and SA is based on the importance priority K, see also [3]. By denoting the *Speed* and *Steer* parameters of both rule bases as *Speed*_{SA}, *Steer*_{SA} for subgoal approach and *Speed*_{LCA} and *Steer*_{LCA} for local collision avoidance, the effective *Speed* and *Steer* becomes:

$$Speed = Speed_{LCA} \cdot K + Speed_{SA} \cdot (1 - K),$$

$$Steer = Steer_{LCA} \cdot K + Steer_{SA} \cdot (1 - K).$$

If more than two rule bases function together, such a principle can be further applied. In general, for n rule bases to coordinate, n importance priorities, e.g. K_1, K_2, \ldots, K_n should be set. By classifying different situations, the dynamic decision for these parameters can be formulated with fuzzy rules and then integrated in the situation.

4.5 An Algorithm for Motion Control along Subgoals

In order to integrate sensor-based maneuver as well as subgoal approaching in the motion control process, an algorithm *Motion_Control* was developed. The task of this algorithm is to guide the robot from a start position along a given subgoal sequence to the goal position with the help of the rule bases of the fuzzy controller. At the position of the next subgoal, a *finishline* is defined to be orthogonal to the path segment. When the finish-line is crossed, the algorithm switches to the next path segment. The whole algorithm is presented as follows:

Algorithm Motion_Control(in SGL, in head₀); Inputs: SGL - a list of subgoals $\langle Q_0, Q_1, \dots, Q_m \rangle$;

 $head_0$ - start heading of robot; { /* Initialising (set motor pid, etc.) */ i := 0;/* subgoal index */ /* start position of robot */ $POS := Q_0;$ HDG := head₀; /* start heading of robot */ while i<m do { /* previous subgoal */ $PSG := Q_i;$ NSG := Q_{i+1} ; /* next subgoal */ i := i+1;/* calculate direction of current path segment and the finish_line at NSG */precalculations: while (finish_line was not crossed) do { $S := read_sensor_data;$ $/^*$ calculate new position and heading by evaluating incremental sensor differences */ HDG := calc_new_hdg(POS,S); $POS := calc_new_pos(POS,S);$ /* angular divergence between robot and path segment heading */ $a := calc_angle(HDG, subseg_hdg);$ /* shortest distance */ $d := calc_distance(POS, PSG, subseg_hdg);$ /* evaluate rule bases */ eval_rule_base_SE(S,K,REPLAN); $eval_rule_base_SA(a,d,STEER_{SA},SPEED_{SA});$ $eval_rule_base_LCA(S, STEER_{LCA}, SPEED_{LCA});$ /* weighting */ $STEER = K * STEER_{LCA} + (1-K) * STEER_{SA};$ $SPEED = K * SPEED_{LCA} + (1-K) * SPEED_{SA};$ if REPLAN then { $replan_new_subgoal_list(POS,SGL);$ **call** Motion_Control(SGL, HDG); } compute_motor_velocities(STEER,SPEED); output_to_actuators; } } }

Experiments have demonstrated the nice modular features of this concept, Fig. 4. The rule base SA alone works well for realising its subgoal approaching subtask in a completely known environment. As

expected, the test in a completely unknown environment with the rule base LCA shows that collisions with obstacles can be avoided, but the robot can possibly move into a dead-end. In a partially-known environment, SA and LCA are coordinated by the rule base situation evaluation, realise the global subgoalguided collision-free motion.



Figure 4: A test environment

5 Conclusions

A fuzzy controller is used for executing subgoalguided motions. Fuzzy rule bases, like local collisionavoidance, can work together with the rule base for passing through subgoals, each of which with only limited amount of control rules. In this way, during motion between subgoals, the robot does not move along a statically planned trajectory, but under the control of a subgoal-guided, sensor-based controller. On-line sensor data can be evaluated to detect local collisions and the motion control is adapted to the dynamic environment.

The modular design features enable a significant reduction of developing time, which is achieved by simple design of a single rule base, fast prototyping and efficient debugging. Further fuzzy rule bases, such as for dealing with the commands from other robots or a human user, can be separately developed by using heuristics or training. Due to the parallel characteristics of fuzzy control, these rules can be processed in real time during each control cycle. In our opinion, fuzzy control is a promising approach for realising efficient and robust robot motions.

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A Appendix A - Rule Base SA (Subgoal Approaching)

Rules for tracing the path and approach the next subgoal, with a = angle between the orientation of the robot and the planned path segment and d = shortest distance between path and robot.

| | | Rules | for the | e outpu | t varial | ble <i>Steer</i> | , | |
|---|-----|-------|---------|---------|----------|------------------|-----|-----|
| | | | | | а | | | |
| | | nb | n m | n | z | р | рm | рb |
| | nb | pb | pь | рm | рm | Р | z | n |
| | n m | рb | рb | pm | pm | Р | z | n |
| | n | рb | рb | pm | р | z | n | n b |
| d | z | рb | pm | р | z | n | n m | n b |
| | Р | рb | Р | z | n | n m | n b | n b |
| | pm | Р | z | n | n m | n m | n b | n b |
| | рb | р | z | n | n m | n m | nb | n b |

| Rules for the output variable Speed | | | | | | | | | | | |
|-------------------------------------|-----|------|------|------|------|------|------|------|--|--|--|
| | | | a | | | | | | | | |
| | | nb | n m | n | z | Р | рm | pь | | | |
| | nb | low | low | low | high | high | vh | high | | | |
| d | n m | low | low | low | high | high | high | high | | | |
| | n | low | low | high | high | vh | high | low | | | |
| | z | low | low | high | vh | high | low | low | | | |
| | Р | low | high | v h | high | high | low | low | | | |
| | pm | high | high | high | high | low | low | low | | | |
| | рb | high | v h | high | high | low | low | low | | | |

B Appendix B - Rule Base LCA (Local Collision Avoidance) and SE (Situation Evaluation)

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| vi vi vi high vh vi nb vh low vi low high high vh vi nb vh low vi vi vi vi vh vh vh vh low vi vi vi vi vh vh vh low vi vi vi vi vi vi vi low low high vh vi vi vi vi vi low low vi vi vi vi vi vi low low low vi vi vi vi vi low low vi vi vi vi vi vi low low vi vi vi vi vi vi low low vi vi vi vi vi vi | vl | vl | vl | low | vh | vl | nb | vh | low | |
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| vilowhighvhvivinbvhlowvivivivivivhvhvinbvhlowvivivivhvhvhvhvhvhlowvilowvhvhvhvhvhvhvhlowlowhighvhvhvhvhvhvhlowlowlowlowvivivivivilowlowlowlowlowlowvivivivilowlowlowlowlowlowlowvivivivilowlowlowlowlowvivivivivivilowlowlowlowvivivivivivivihighlowlowvivivivivivivihighlowvivivivivivivivihighlowvivivivivivivilowvivivivivivivivivilowhighlowvivivivivivilowvivivivivivivivivivivivivivivivivi< | vl | vl | low | high | vh | vl | nb | vh | low | |
| vivivivivivhvhvhlowvivivhvhvhvhvhvhlowvivivhvhvhvhvhvhlowlowvivivivivivinbvhlowvivivivivinbhighplowlowvivivivinbhighlowlowlowvivivivivivinblowlowlowvivivivinbhighlowlowlowlowvivivinbhighlowlowlowvivivivinonohighlowvivivivivinonohighlowvivivivivinonohighhighvivivivivinonovhnighhighvivivivinonovhnighhighnighvivivinonighhighnighvivivivinonighnighnighvivivinonovhnighnighvivivinononighnighnighvivivi <td>vl</td> <td>low</td> <td>high</td> <td>high</td> <td>vh</td> <td>vl</td> <td>nb</td> <td>vh</td> <td>low</td> | vl | low | high | high | vh | vl | nb | vh | low | |
| vivilowvhvhvinbvhlowvilowvhvhvhvhvhvhlowlowhighvhvhvhvhvhvhlowlowvivivivivinbvhlowlowlowvivivivilowlowlowlowlowlowlowvivivivilowlowlowlowlowvivivivivilowlowlowlowlowvivivivivilowlowlowlowlowvivivivivilowlowhighvivivivivivivivilowhighlowlowvivivivivilowhighhighvivivivivivilowhighlowvivivivivilowvhvivivivivivivilowhighlowvivivivivilowvivivivivivivilowvivivivivivivivivivivivivivivivivivivi </td <td>vl</td> <td>vl</td> <td>vl</td> <td>vh</td> <td>vh</td> <td>vl</td> <td>nb</td> <td>vh</td> <td>low</td> | vl | vl | vl | vh | vh | vl | nb | vh | low | |
| vivivhvhvivinbvhlowlowhighvhvhvhvhvhlowlowlowlowCollisionavoidancein free space - Obstaclefrom leftlowlowvivivivihighplowlowlowlowlowvivivivipbhighlowlowlowlowlowvivivivivivipbhighlowlowlowlowvivivivivivipbhighlowlowlowlowvivivivivivipbvhlowhighlowvivivivivivivipbvhlowhighhighvivivivivivipbvhlowvhhighhighvivivivivipbvhlowvhhighhighvivivivivipbvhlowvhhighlowvivivivivivivivivhhighlowvivivivivivivivhvhvivivivivivivivivivivivi <td< td=""><td>vl</td><td>vl</td><td>low</td><td>vh</td><td>vh</td><td>vl</td><td>nb</td><td>vh</td><td>low</td></td<> | vl | vl | low | vh | vh | vl | nb | vh | low | |
| viiowvhvhvhvlnbvhlowlowlowinfree space - Obstaclefrom left-lowlowvivivivilowlowlowlowlowlowvivivivilowlowlowlowlowvivivilowlowlowlowlowlowvivivilowlowlowlowlowvivivivilowlowlowlowvivivivivihighvivivivivivivihighlowlowvivivivivihighlowlowvivivivivihighhighvivivivivivivhvivivivivivivivhvi <td>vl</td> <td>vl</td> <td>vh</td> <td>vh</td> <td>vh</td> <td>vl</td> <td>nb</td> <td>vh</td> <td>low</td> | vl | vl | vh | vh | vh | vl | nb | vh | low | |
| lowhighvhvhvlnbvhlowCollision avoidance in free space - Obstaclefrom leftlowlowvlvlvlhighplowlowlowlowlowvlvlvllowpbhighlowlowlowlowlowlowvlvlvlvlpbhighlowlowlowlowlowvlvlvlvlvlpbhighlowlowhighlowvlvlvlvlvlpbhighlowlowhighlowvlvlvlvlvlpbvhlowhighhighvlvlvlvlpbvhlowvhlowvlvlvlvlpbvhlowvhlowvlvlvlvlpbvhlowvhlowvlvlvlvlpbvhlowvhlowvlvlvlvlpbvhlowvhlowvlvlvlvlvlvlvlvhlowvlvlvlvlpbvhlowvhlowvlvlvlvlvlvllowvhlowvlvlvlvlvlvllowvhhighlowvlv | vl | low | vh | vh | vh | vl | nb | vh | low | |
| Colstacle from leftlowvlvlvlvllowpmlowlowlowlowlowlowlowvlvlvlvlvlvlvlvllowvl </td <td>low</td> <td>high</td> <td>vh</td> <td>vh</td> <td>vh</td> <td>v l</td> <td>nb</td> <td>vh</td> <td>low</td> | low | high | vh | vh | vh | v l | nb | vh | low | |
| lowvivivivivihighplowlowlowlowlowlowvivivivivivivilowlowlowvivivivivivivivivihighlowvivivivivivivivivivivihighlowvivivivivivivivivivivihighhighvivivivivivivivivivivivihighhighvi< | Collisi | on avoida | ance in fre | ee space - | Obstacle | from le | ft | | | |
| lowlowlowlowlowlowlowlowlowlowlowlowlowlowpbhighlowhighlowlowlowlowpbhighlowhighlowvlvlvlvlvlpbhighlowhighlowlowvlvlvlvlpbvhlowhighlowlowvlvlvlvlpbvhlowhighhighnighvlvlvlvlpbvhlowvhpbvhvlvlvlvlvlvlvlvllowvhhighhighvlvlvlvlpbvhlowvhlowvhvhvlvlvlvlvlvlvlvllowvhlowvhhighlowvlvlvlvlvlvlvllowvhlowvhvhvlvlvlvlvlvlvlvlvllowvhlowvhvhvhvlvlvlvlvlvlvlvlvllowvhvhvhvlvlvlvlvlvlvlvlvlvlvhvhvhvlvlvlvlvlvlvlvlvl | low | vl | vl | vl | vl | high | Р | low | low | |
| lowlowlowvlvllowpbhighlowlowlowvlvlvlvlvlpbhighlowhighlowvlvlvlvlvlvlpbhighlowhighlowlowvlvlvlvlvlpbvhlowhighhighvlvlvlvlvlvlpbvhlowvhvlvlvlvlvlvlpbvhlowvhvlvlvlvlvlvlpbvhlowvhvlvlvlvlvlpbvhlowvhhighlowvlvlvlpbvhlowvhvhvlvlvlvlpbvhlowvhvhvlvlvlvlpbvhlowvhvhvhvlvlvlvlpbvhlowvhvhvhvlvlvlvlvlvlvlvhlowvhvhvhvlvlvlvlvlvlvlvlvlvhvhvhvlvlvlvlvlvlvlvlvlvhvhvhvlvlvlvlvlvlvlvlvlvlvh <t< td=""><td>low</td><td>low</td><td>vl</td><td>vl</td><td>vl</td><td>low</td><td>pm</td><td>low</td><td>low</td></t<> | low | low | vl | vl | vl | low | pm | low | low | |
| lowlowlowlowvivivivivivipbhighlowhighlowvivivivivivivipbhighlowhighlowvivivivivivivivivilowhighhighvivivivivivivivivivihighhighvivivivivivivivivivivhlowvivivivivivivivivivilowvhlowvivivivivivivilowvilowvilowvhhighlowvivivivivilowvilowvilowvilowvhhighlowvivivivivilowvilowvivilowlowvivilowvivilowvivilowvivivilowvivivivilowvivivivilowvi< | low | low | low | vl | vl | low | рb | high | low | |
| hìghvivivivivivivipmhìghlowhìghlowlowvivivivipbvhlowhìghhighvivivivivipbvhlowhìghhighhighvivivivipbvhlowvhvivivivivivipbvhlowvhhighvivivivipbvhlowvhhighlowvivivipbvhlowvhhighlowvivivipbvhlowvhhighlowvivivipbvhlowvhvhvivivivivipbvhlowvhvhvivivivivipbvhlowvhvhvhvivivivipbvhlowvhvhvhvivivivipbvhlowvhvhvhvivivivipbvhlowvhvhvhvivivivivivivivhvhvhvivivivivivivivivivhvivivivivivivi | low | low | low | low | vl | low | рb | high | low | |
| hìghlowvivivivivivivivipbhìghlowhìghhìghvivivivivivipbvhlowhìghhìghvivivivivipbvhlowvhhìghhìghvivivivivipbvhlowvhhìghlowvivivivipbvhlowvhhìghlowvivivipbvhlowvhhìghlowvivivipbvhlowvhhìghlowvivivipbvhlowvhvhvivivivipbvhlowvhvhvivivivivilowvivhvhvhvivivivilowvivhvhvhvivivivilowvivhvhvhvivivivivilowvivivivivivivivilowvivivivivivivivilowvivivivivivivivilowvivivivivivivivilowvivivivi </td <td>high</td> <td>vl</td> <td>vl</td> <td>vl</td> <td>vl</td> <td>low</td> <td>p m</td> <td>high</td> <td>low</td> | high | vl | vl | vl | vl | low | p m | high | low | |
| hìghlowlowvivivivivivivipbvhlowhìghhìghhìghvivivivivipbvhlowvhvivivivivivivipbvhlowvhhìghvivivivivipbvhlowvhhìghlowvivivipbvhlowvhhìghlowvivivipbvhlowvhhìghlowvivivipbvhlowvhvhvivivivipbvhlowvhvhvhvivivipbvhlowvhvhvhvivivivipbvhlowvhvhvhvivivivivilowvivivivivivivivivivivilowvi | high | low | vl | vl | vl | vl | pь | high | low | |
| hìgh hìgh vi vì vì vì vì pb vh low vh vì vì vì vì vì vì vì pb vh low vh hìgh low vì vì vì vì pb vh low vh hìgh low vì vì vì vì pb vh low vh hìgh low vì vì vì pb vh low vh hìgh low vì vì vì pb vh low vh vh vh vì vì vì vì pb vh low vh vh vh vì vì vì vì pb vh low vh vh vh vì vì vì vì pb vh low vh vh vh vì vì vì vì pb vh low vh vh vh vì vì vì vì pb vh low vh vh vh vh vì vì vì vì pb vh low vh vh vh vh low vì vì vì pb vh low vh vh vh vh low vì vì vì pb vh low vh vh vh vh low vì vì vì pb vh low vh vh vh vh low vì vì vì pb vh low vh vh vh vh low vì vì vì pb vh low vh vh vh vh low vì vì vì pb vh low vh vh vh vh low vì vì vì pb vh low vh vh vh vh low vì vì vì pb vh low vì vì vì hìgh vì vì vì vì z vh low vì vì vì hìgh vì vì vì vì z vh low vì vì vì hìgh vì vì vì vì pb vh low vì vì vh vh vh vì vì vì vì pb vh low vì vì vh vh vh vì vì vì vì pb vh low vì low hìgh low vì vì vì pb vh low vì hìgh vh hìgh vì vì vì pb vh low vì vì vh vh vh vì vì vì pb vh low vì low hìgh low vì vì vì pb vh low vì low hìgh vì vì vì pb vh low vì low hìgh vì vì vì pb vh low vì low hìgh vì vì vì pb vh low vì vì vh vh vì vì vì pb vh low vì vì vh vh vì vì vì vì pb vh low vì vì hìgh vh vì vì vì pb vh low vì vì vh vh vì vì vì vì pb vh low vì vì vh vh vì vì vì vì pb vh low vì vì vh vh vì vì vì vì pb vh low vì vì vh vh vì vì vì vì pb vh low vì vì vh vh vì vì vì vì pb vh low vì vì vh vh hìgh vì vì vì pb vh low vì vì vì vh hìgh vì vì vì pb vh low vì vì vì vh hìgh vì vì vì pb vh low vì vì vì vh hìgh vì vì vì pb vh low vì vì vì vh hìgh vì vì vì pb vh low vì vì vì vh hìgh vì vì vì pb vh low vì vì vì vh hìgh vì vì vì pb vh low vì vì vì vh hìgh vì vì vì pb vh low vì vì vì vh hìgh vì vì vì nb vh low vì vì vì hìgh vh vì vì vì nb vh low vì vì vì hìgh vh vì vì nb vh low vì vì vì hìgh vh vì vì nb vh low vì vì vì hìgh vh vh vì vì nb vh low vì vì vì hìgh vh vh vì vì nb vh low vì vì vì vh vh vh vì vì nb vh low vì vì vì vh vh vh vì vì nb vh low vì vì vì vh vh vh vì vì nb vh low vì vì vì vh vh vh vì vì nb vh low | high | low | low | vl | vl | vl | pь | vh | low | |
| highhighhighvlvlvlvlvlvlvlvlvlpbvhlowvhlowvlvlvlvlvlvlpbvhlowvhhighvlvlvlvlvlpbvhlowvhhighlowvlvlvlvlpbvhlowvhhighhighlowvlvlvlpbvhlowvhvhvlvlvlvlpbvhlowvhvhvhvlvlvlpbvhlowvhvhvhvlvlvlpbvhlowvhvhvhvlvlvlpbvhlowvhvhvhvlvlvlvlpbvhlowvhvhvhvlvlvlvlvlvllowvlvlvhvhvlvlvlvlvlvllowvlvlvhvlvlvlvlvlvlvlvlvlvlvlvhvlvlvlvlvlvlvlvlvlvlvhvhvlvlvlvlvlvlvlvlvlvlvlvhvlvlvlvlvlvlvlvl <td>high</td> <td>high</td> <td>vl</td> <td>vl</td> <td>vl</td> <td>vl</td> <td>pь</td> <td>vh</td> <td>low</td> | high | high | vl | vl | vl | vl | pь | vh | low | |
| vhvlvlvlvlvlvlvlvlvlpbvhlowvhhighvlvlvlvlvlpbvhlowvhhighlowvlvlvlpbvhlowvhhighlowvlvlvlpbvhlowvhvhvlvlvlvlpbvhlowvhvhvhvlvlvlpbvhlowvhvhvhvlvlvlpbvhlowvhvhvhvhvlvlpbvhlowvhvhvhvlvlvlvlpbvhlowvhvhvhvhvlvlvlvlpbvhlowvhvhvhvhvlvlvlvlvllowvlvlvlvlvlvlvlvllowvhlowvlvlvhvlvlvlvlvlvllowvhlowvlvlvhvlvlvlvlvlvllowvlvlvlvlvhvlvlvlvlvlvlvllowvlvlvlvlvhvhvlvlvlvlvlvlvlvlvlv | high | high | high | vl | vl | vl | рb | vh | low | |
| vhlowvlvlvlvlvlvlvlpbvhlowvhhighlowvlvlvlpbvhlowvhhighlowvlvlvlpbvhlowvhvhvlvlvlvlpbvhlowvhvhvhvlvlvlpbvhlowvhvhvhvlvlvlpbvhlowvhvhvhvhvlvlvlpbvhlowvhvhvhvhvlvlvlvlpbvhlowvhvhvhvhvlvlvlvlpbvhlowvlvlvlvlvlvlvlvlvllowvlvlvlvlvlvlvlvlvlvlvlvllowvlvlvlvlvlvlvlvlvlvlvllowvlvlvlvhvlvlvlvlvlvlvlvlvllowvlvlvhvlvlvlvlvlvlvlvlvlvlvlvlvhvlvlvlvlvlvlvlvlvlvlvllowvhvlvlvlvl< | vh | vl | vl | vl | vl | vl | рb | vh | low | |
| vhhighvlvlvlvlvlvlvlpbvhlowvhhighhowvlvlvlpbvhlowvhvhvlvlvlvlpbvhlowvhvhvlvlvlvlpbvhlowvhvhvhvlvlvlpbvhlowvhvhvhvhvlvlpbvhlowvhvhvhvhvlvlpbvhlowAvoiding direct collision with obstacle ahead | vh | low | vl | vl | vl | vl | pь | vh | low | |
| vhhighlowvlvlvlvlvlpbvhlowvhhighlowvlvlvlpbvhlowvhvhvlvlvlvlpbvhlowvhvhvhvlvlvlpbvhlowvhvhvhvlvlvlpbvhlowvhvhvhvlvlvlpbvhlowvhvhvhvhvlvlvlpbvhlowvhvhvhvhvlvlvlvlvlvhlowvlvlvhvlvlvlvlvlvhlowvlvllowvlvlvhvhvlvlvlvlvlvllowvllowvlvlvhvhvlvlvlvlvlvllowvllowvlvhvhvlvlvlvlvlvlvllowvlvllowvllowvhvlvlvlvlvlvlvlvllowvlvllowvhvlvlvlvlvlvlvlvlvlvlvllowvhvlvlvlvlvlvlvlvlvlvlvl <t< td=""><td>vh</td><td>high</td><td>vl</td><td>vl</td><td>vl</td><td>vl</td><td>pь</td><td>vh</td><td>low</td></t<> | vh | high | vl | vl | vl | vl | pь | vh | low | |
| vhhighhighlowvlvlvlvlpbvhlowvhvhlowvlvlvlpbvhlowvhvhvhvhvlvlpbvhlowvhvhvhvhvlvlpbvhlowvhvhvhvhvlvlpbvhlowvhvhvhvhvlvlpbvhlowvhvhvhvhvlvlvlpbvhlowvlvllowvlvlvlvlvlvhlowvlvlvlvlvlvlvlvlvhlowvlvlvlvlvhvhvlvlvlvlvlvlvllowvlvlvhvhvlvlvlvlvlvlvlvlvllowhighvlvlvlvlvlvlvlvlvlvllowhighvlvlvlvlvlvlvlvlvlvllowhighvlvlvlvlvlvlvlvlvlvllowhighvlvlvlvlvlvlvlvlvlvllowvhvlvlvlvlvlvlvl <td>vh</td> <td>high</td> <td>low</td> <td>vl</td> <td>vl</td> <td>vl</td> <td>pь</td> <td>vh</td> <td>low</td> | vh | high | low | vl | vl | vl | pь | vh | low | |
| vhvhvlvlvlvlvlvlvlpbvhlowvhvhvhvhvlvlpbvhlowvhvhvhvhvhvlvlpbvhlowvhvhvhvhvhvlpbvhlowAvoiding direct collision with obstacle aheadvlvlvlvlvlvlvlvhlowvlvlvhvhvhvhlowvhlowvlvlvhvhvlvlvlvhlowvlvhhighvhvlvlvhlowvhlowvlvhhighhighvlvlvlvhlowvhlowvllowhighhighvlvlvlvhlowvhlowvlhighhighvlvlvlvlvhlowvhlowvllowvhvlvlvlvhlowvhlowvhlowvllowvhvlvlvlvlvhlowvhlowvhlowvllowvhvlvlvlvhlowvhlowvhlowvhlowvllowvhvlvlvlvhlowvhlowvhlowvhlow </td <td>vh</td> <td>high</td> <td>high</td> <td>low</td> <td>vl</td> <td>vl</td> <td>pb</td> <td>vh</td> <td>low</td> | vh | high | high | low | vl | vl | pb | vh | low | |
| vhvhlowvlvlvlvlvlpbvhlowvhvhvhvhvhvhvhlowvlvhlowvhvhvhvhvhlowvlvlpbvhlowAvoiding direct collision with obstacle aheadvlvllowvlvlvlzhighlowvlvlvlvlvlvlvlvhlowvlvlvhvlvlvlvlvhlowvlvlvhvlvlvlvlvhlowvlvlvhvhvlvlvlvhlowvllowhighvlvlvlvlvhlowvlhighvhvhvlvlvlvhlowvllowhighvlvlvlvlvhlowvllowhighvlvlvlvhlowlowvllowvhvlvlvlvhlowlowvllowvhvlvlvlvhlowlowvllowvhvlvlvhlowlowvllowvhvlvlvhlowlowvllowvhvlvlvhlowlowvllowvlvlvl< | vh | vh | vl | vl | vl | vl | pь | vh | low | |
| vhvhvhvhvlvlvlvlvlpbvhlow vh vhvhvhvhhighlowvlvlpbvhlow $Avoiding direct collision with obstacle aheadvlvllowvlvlvlvlvlvllowvlvlvlvlvlvlvlvlvllowvlvlvhvlvlvlvlvllowvlvhhighhighvlvlvlvhlowvllowhighhighvlvlvlvhlowvlhighnighvhvlvlvhlowvhlowvlhighvhvhvlvlvhlowlowvhlowvllowhighvlvlvlvhlowlowvhlowvllowhighvlvlvlvhlowlowvhlowvllowhighvlvlvlvhlowvhlowlowvllowvhvlvlvlvhlowvhlowvllowvhvlvlvlpbvhlowvllowvhvlvlvlvhlowlowvllowvhvlvlvlvhlow$ | vh | vh | low | vl | vl | vl | pь | vh | low | |
| vhvhvhiowvivipivhlowvhvhvhvhhighlowvipbvhlowAvoiding direct collision with obstacle aheadvivihighvivilowzhighlowvivivhvivivizvhlowvivivhvivivivilowzvhlowvivivhvivivivivilowzvhlowvihighhighhighvivivivivilowvilowvihighvhhighvivivivipbvhlowvihighvhvivivipbvhlowvilowvilowhighvivivipbvhlowvivilowvilowvivivivivipbvhlowvivilowvilowvivivivivivivivilowvivilowvilowvivivivivivivilowvivilowvilowvilowvivivivivivivivivilowvilowvilow | vh | vh | vh | , vl | vl | vl | pb | vh | low | |
| vhvhvhhighlowvlvlpbvhlowAvoiding direct collision with obstacle headvlvllowvlvlvlvlvllowzhighlowvlvlhighvlvlvlvlvlvllowzvhlowvlvlvlvlvlvlvlvlvlvllowzvhlowvllowhighhighlowvlvlvlvlvllowvllowvlvlvllowvlvlvlvlvllowvl <td>vh</td> <td>vh</td> <td>vh</td> <td>low</td> <td>, vl</td> <td>vl</td> <td>pb</td> <td>vh</td> <td>low</td> | vh | vh | vh | low | , vl | vl | pb | vh | low | |
| <th a="" and="" column="" is="" l<="" low="" of="" state="" td="" the=""><td>vh</td><td>vh</td><td>vh</td><td>high</td><td>low</td><td>v !</td><td>рь</td><td>vh</td><td>low</td></th> | <td>vh</td> <td>vh</td> <td>vh</td> <td>high</td> <td>low</td> <td>v !</td> <td>рь</td> <td>vh</td> <td>low</td> | vh | vh | vh | high | low | v ! | рь | vh | low |
| vivivivivivivizihighlowvivivivivivivivivilowvivivivivivivivivilowvihighhighlowvivivizvhlowvihighhighvivivizvhlowvihighvhhighvivivipbvhlowvihighvhvivivipbvhlowvilowhighvivivipbvhlowvilowhighvivivipbvhlowvilowlowvivivipbvhlowvilowlowvivivipbvhlowvilowlowvivivipbvhlowvivhvhvivivipbvhlowvivhvhvivivipbvhlowvivhvhvivivipbvhlowvivhvhvivivipbvhlowvivhvhvivivivivilowhighvhvivivivivilow <t< td=""><td>Avoidi</td><td>ng direct</td><td>collision</td><td>with obs</td><td>tacle ahea</td><td>d</td><td></td><td></td><td></td></t<> | Avoidi | ng direct | collision | with obs | tacle ahea | d | | | | |
| viviviviviviviviviowvilowhighhighlowvilowzvhlowvilowhighhighhighvivivivilowvihighhighhighvivivivivilowvihighvhvhvivivivilowdvidingdirect collisionwith obstaclefromhiff-left/righttowvilowhighvivivipbvhlowvilowhighvivivipbvhlowvilowvivivivipbvhlowvilowvivivivipbvhlowvivhhighvivivipbvhlowvivhvhvivivipbvhlowvivhvhvivivipbvhlowhighvhvhlowvivipbvhlowvivhvhlowvivipbvhlowvivhhighvivivipbvhlowlowvhlowvivipbvhlowvivhhighvivivipbvhlow | vl | vl | low | vl | vl | low | z | high | low | |
| vivivivivivivivipbvhlowvihighhighhighvivivivivilowvivihighvhhighvivivivipbvhlowvihighvhhighvivivipbvhlowdigitactcollisionwith obstaclefromhalf-left/rightvilowvhvivivipbvhlowvilowvhvivivipbvhlowvilowvhvivivipbvhlowvilowvivivivipbvhlowvihighvhvivivipbvhlowvivhhighvivivipbvhlowvivhhighvivivipbvhlowvivhhighvivivipbvhlowlighvhvhvivivipbvhlowvivhhighvivivipbvhlowvivhhighvivivipbvhlowlighvhvhvivivipbvhlowvivhhighvivivipb< | vl | vl | high | vl | vl | vl | z | vh | low | |
| vilowhighhighlowvilowzvhlowvlhighvhhighvlvlvlvlvllowvlhighvhvhvlvlvlvlpbvhlowvlhighvhvhvlvlpbvhlowAvoiding direct collision with obstacle from half-left/rightvllowhighvlvlpbvhlowvllowhighvlvlpbvhlowvllowhowvlvlpbvhlowvllowlowvlvlpbvhlowvlhighvhvlvlpbvhlowvlvhhighvlvlvlpbvhlowvlvhvhvlvlvlpbvhlowvlvhvhvlvlvlpbvhlowvlvhvhvhvlvlvlvblowhighvhvhvhvlvlpbvhlowvlvhvhhighvlvlvlpbvhlowvlvhvhvlvlvlvlvlvhlowvlvhvhvhvlvlvlvhlowvllowvhvhhigh< | vl | vl | vh | v! | vl | v I | рь | vh | low | |
| vinignnignnignnignvivivizivhlowvihighvhhighvivipbvhlowlowAvoiding direct collision with obstacle from half-left/rightvilowhighvivilowpbvhlowvilowhighvivilowpmvhlowvilowhighvivivipbvhlowvilowvivivivipbvhlowvilowvivivivipbvhlowvihighvhvivivipbvhlowvivhhighvivivipbvhlowvivhvhvivivipbvhlowvivhvhvivivipbvhlowhighvhvhvivivipbvhlowhighvhvhvivivipbvhlowhighvhvhvivivipbvhlowvivihighlowvivipbvhlowvivihighvivivinbvhlowvivihighvivivinbvhlowvivi | VI | 10 W | nigh | 10W | vi | IOW | z | vh | low | |
| vinignvnnignvivivivipbvhlow vi vhvhvhvivipbvhlowAvoiding direct collision with obstacle from half-left/rightvilowhighvivivipbvhlowvilowvhvivipbvhlowvilowlowvivivipbvhlowvilowlowvivivipbvhlowvilowlowvivivipbvhlowvivhhighvivivipbvhlowvivhvhvivivipbvhlowvivhvhvivivipbvhlowhighvhvhhighvivipbvhlowhighvhvhhighlowvipbvhlowhighvhvhhighlowvipbvhlowhighvhvhhighlowvipbvhlowvivivilowvivipbvhlowvivivhhighlowvivipbvhhighvhvhvivivinbvhlowvivihighvi <td< td=""><td>VI</td><td>nigh</td><td>nigh</td><td>nigh</td><td>vi</td><td>VI</td><td>z</td><td>vh</td><td>low</td></td<> | VI | nigh | nigh | nigh | vi | VI | z | vh | low | |
| vivivivivivivivivivilowAvoiding direct collision with obstacleform half-left/rightvilowhighvivilowpmvhlowvilowvhvivivipbvhlowvilowvhvivivipbvhlowvilowvhvivivipbvhlowvivhhighvivivipbvhlowvivhvhvivivipbvhlowvivhvhvivivipbvhlowlowvivivivipbvhlowhighvhvhvivivipbvhlowhighvhvhhighvivipbvhlowhighvhvhhighvivipbvhlowhighvhvhhighvivipbvhlowhighvhvhvivivipbvhlowvivivhhighlowvipbvhlowhighvhhighvivinbvhlowhighvhlowvivinbvhlowvivivhhighvivi< | VI 1 | nign | vn | nign | VI | | p b b b | vn vr | Low | |
| Notice of the product | VI A | vn nædire f | vn sollisisi | vn | vi taclo fre | h alf le f | pp F/nicht | VП | TOW | |
| vilownighvivilowpmvhlowvilowlowvivivipbvhlowvilowlowvivivipbvhlowvihighvhvivivipbvhlowvivhhighvivivipbvhlowvivhvhvivivipbvhlowvivhvhvivipbvhlowlowvivivipbvhlowhighvhvhvivipbvhlowhighvhvhhighvivipbvhlowhighvhvhhighlowvivipbvhlowvivivilowvivipbvhlowvivivilowvivinbvhlowvivivhhighlowvivinbvhlowvivivihighvivivinbvhlowvivivhhighvivinbvhlowvivivhhighvivinbvhlowvivivhvhvhvinbvhlowvivivhvh <td< td=""><td>AVOID</td><td>ng airect</td><td>LIT</td><td>WILL ODS</td><td>sacie from</td><td>nair-iei</td><td>t/right</td><td></td><td>1.</td></td<> | AVOID | ng airect | LIT | WILL ODS | sacie from | nair-iei | t/right | | 1. | |
| vilowvnvivivivivipovhlowvilowpwlowvivivipbvhlowvihighvhvivivivipbvhlowvivhvhvivivivipbvhlowvivhvhvivivipbvhlowlowhighhighvivivipbvhlowhighvhvhvivivipbvhlowhighvhvhhighvivipbvhlowhighvhvhhighlowvipbvhlowvivivilowvivipbvhlowvivivilowvivinbvhlowvivivilowvivinbvhlowvivivilowvivinbvhlowvivivivivinbvhlowvivivhvhvivinbvhlowvivivhvhvivinbvhlowvivivhvhvivinbvhlowvivivhvhvhvinbvhlow <t< td=""><td>vi</td><td>10 W</td><td>nigh</td><td>VI </td><td>vi</td><td>TOW</td><td>pm</td><td>vh</td><td>low</td></t<> | vi | 10 W | nigh | VI | vi | TOW | pm | vh | low | |
| viiowiowviviviiowpmhighlowvihighvhvivivipbvhlowvivhhighvivivivipbvhlowlowhighhighvivivivipbvhlowlowhighhighlowvivipbvhlowhighvhhighvivivipbvhlowhighvhvhhighvivipbvhlowhighvhvhhighvivipbvhlowhighvhvhhighvivipbvhlowvivihighlowvivipbvhlowvivihighlowvipbvhlowvivihighlowvinbvhlowvivivhhighvinbvhlowvivivhvhvivinbvhlowvivivhvhvhvinbvhlowvivivhvhvhvinbvhlowvivivhvhhighvinbvhlowvivivhvhvhvinbvhlowvilow <td>vi</td> <td>10 W</td> <td>vh</td> <td>VI </td> <td>vi</td> <td>VI I sm</td> <td>рь</td> <td>vh biab</td> <td>low</td> | vi | 10 W | vh | VI | vi | VI I sm | рь | vh biab | low | |
| vinighvnvivivivivipovhlowvivhhighlowvivipbvhlowlowhighhighlowvivipbvhlowhighvhhighvivivipbvhlowhighvhhighvivivipbvhlowhighvhvhhighvivipbvhlowhighvhvhhighlowvipbvhlowvivivilowvivimmvhlowvivivilowvivinbvhlowvivivilowvivinbvhlowvivivivivivinbvhlowvivivivivinbvhlowvivivhvhvivinbvhlowvivivhvhvivinbvhlowvivivhvhvivinbvhlowvivivhvhvivinbvhlowvivivhvhvhvinbvhlowvivivhvhvhvinbvhlowvivivh< | VI | low bieb | 10 W | V I | VI | IOW | pm | nign | low | |
| vivivivivivivivivipovhlowlowhighhighlowvivivipbvhlowhighvhhighvivivivipbvhlowhighvhhighvivivivipbvhlowhighvhvhhighvivivipbvhlowhighvhvhhighvivivipbvhlowvivihighlowvivipbvhlowvivihighlowvivipbvhlowvivivhhighvivinbvhlowvivivilowvivinbvhlowvivivhhighvivinbvhlowvivivhvhvivinbvhlowvivivhvhvivinbvhlowvilowvhvhvivinbvhlowvivivhvhvinbvhlowvilowvhvhhighvinbvhlowvilowvhvhhighvinbvhlowvilowvhvhhighv | VI | nign | vn hi | V I | VI | VI T | p b p b | vn wb | low | |
| vivivivivivivipovhlowlowhighvhlowvivipbvhlowhighvhhighvivivipbvhlowhighvhvhlowvivipbvhlowhighvhvhhighvivipbvhlowhighvhvhhighlowvipbvhlowvivivilowvivimmvhlowvivivilowvivimhhighlowvivivilowvivimhhighlowvivivivivivinbvhlowvivivivivivinbvhlowvivivivivinbvhlowvivivhvhvinbvhlowvivivhvhvinbvhlowvilowvhvhhighvinbvhlowvilowvhvhhighvinbvhlowvilowvhhighvhhighvinbvhlowvilowvhvhhighvinbvhlowvivivhvh </td <td>VI 1</td> <td>v n</td> <td>nign</td> <td>VI </td> <td>VI</td> <td></td> <td>p b b b</td> <td>vn vr</td> <td>Low</td> | VI 1 | v n | nign | VI | VI | | p b b b | vn vr | Low | |
| lownighnighlowvivivivipovhlowhighvhvhvhvhvhpbvhlowhighvhvhvhvhvhvhlowhighvhvhhighvhvhpbvhlowhighvhvhhighlowvlvlpbvhlowvlvlhighlowvlvlpbvhlowvlvlhighlowvlvlnbvhlowvlvllowlowvlvlnbvhlowvlvlvhhighvlvlvlnbvhlowvlvlvhvhvlvlnbvhlowvlvlvhvhvlvlnbvhlowvlvlvhvhvhnbvhlowvllowvhvhhighvlnbvhlowvllowvhvhhighvlnbvhlowvllowvhvhhighvlnbvhlowvllowvhvhhighvlnbvhlowvllowvhvhhighvlnbvhlowvllowvhvhhighvlnbvhlow <t< td=""><td>VI</td><td>v h</td><td>vh</td><td>VI I</td><td>vi</td><td>VI VI</td><td>p b</td><td>vh</td><td>low</td></t<> | VI | v h | vh | VI I | vi | VI VI | p b | vh | low | |
| n_{igh} v_{i} n_{igh} v_{i} v_{i} v_{i} v_{i} v_{i} p_{i} v_{h} low h_{igh} v_{h} v_{h} h_{igh} v_{h} v_{h} p_{b} v_{h} low h_{igh} v_{h} v_{h} h_{igh} v_{l} v_{l} p_{b} v_{h} low v_{l} v_{l} h_{igh} low v_{l} v_{l} v_{h} low v_{l} v_{l} h_{igh} v_{l} v_{l} v_{l} v_{h} low v_{l} v_{l} v_{h} low v_{l} v_{l} v_{h} low v_{l} v_{l} v_{h} h_{igh} v_{l} v_{l} v_{h} low v_{l} v_{l} v_{h} h_{igh} v_{l} v_{l} v_{h} low v_{l} v_{h} v_{h} h_{igh} v_{h} v_{l} v_{h} low v_{l} v_{h} v_{h} h_{igh} v_{h} h_{igh} v_{h} v_{h} low v_{l} v_{h} v_{h} h_{igh} v_{h} h_{igh} v_{l} v_{h} v_{h} v_{h} v_{l} v_{l} v_{h} h_{igh} v_{h} v_{h} v_{h} v_{h} v_{h} v_{h} v_{l} v_{h} v_{h} v_{h} v_{h} v_{h} v_{h} v_{h} v_{h} v_{h} v_{l} v_{h} v_{h} | low himb | nign | nign bi-b | low | VI | VI T | p b p b | vn wb | low | |
| n_{igh} v_n v_n v_n v_i v_i v_i p_b v_h low high v_h v_h high low v_i p_b v_h low v_i v_i v_h $high$ low v_i p_b v_h low v_i v_i v_h low v_i v_h n_b v_h low v_i v_i v_h low v_i v_i n_b v_h low v_i v_i v_h v_i v_i n_b v_h low v_i v_i v_h v_i v_i n_b v_h low v_i v_h v_h v_h v_i n_b v_h low v_i v_h v_h v_h v_h v_h v_h v_h v_h v_i v_h v_h v_h v_h v_h v_h v_h v_h v_i v_h v_h v_h v_h v_h v_h v_h v_h v_i v_h v_h v_h v_h v_h v_h v_h v_h v_h v_i v_h v_h v_h v_h v_h v_h v_h v_h v_h v_i v_h | high | v II v b | nign vb | vi low | vi 1 | | p b b b | vn vb | low | |
| $n:g_n$ v_n v_n v_n v_n v_n v_n v_n v_n v_n high vh highlow vl pb vh low vl vl highlow vl lownm vh low vl vl how vl lownmhighlow vl vl lowlow vl vlnb vh low vl vl vh high vl vl nb vh low vl vl vh vh vl vl nb vh low vl vl vh vh vl vl nb vh low vl vh vh vh vl vl nb vh low vl vh vh $high$ vl nb vh low vl low vh vh $high$ vl nb vh low vl low vh vh $high$ vl nb vh low vl low vh vh $high$ vl nb vh low vl vl vh vh $high$ vl nb vh low vl $high$ vh vh $high$ vl vh vh vh vl vl vh vh $high$ vl vh vh vh vl vh vh vh | high | v n v b | v n v b | high | vi vl | | p b n b | v n v b | Low | |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | high | v n v h | v n v h | high | low | | p b | v II v h | Low | |
| | | v 11 171 | high | low | 10 W | low | 10 | vh | Low | |
| | vi | vi | vh | low | vi | v1 | nh | vh | Low | |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | vi | v i 171 | low | low | vi | low | 10 | high | Low | |
| <td>vi</td> <td>v i 171</td> <td>v h</td> <td>high</td> <td>vi</td> <td>v1</td> <td>nh</td> <td>vb</td> <td>Low</td> | vi | v i 171 | v h | high | vi | v1 | nh | vb | Low | |
| $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | vl | vi | hiơh | 8" vh | vl | vl | nb | vh | low | |
| vi vi vi vi vi vi low vi low high vi nb vi low vi vi high vi high vi nb vi vi vi high vi high vi nb vi low vi low vi high vi nb vi low vi high vi vi high vi nb vi low high vi vi high vi nb vi low high vi vi nb vi low | vi | vi | vh | vn vh | vi | vi | nb | vh | Low | |
| vi vi nigh vi nigh vi nigh vi nob vi low vh vh high vi nb vh low vi low vh vh high vi nb vh low vi low vh vh high vi nb vh low vi high vh vh high vi nb vh low low high vh vh high vi nb vh low No obstacle in vi vi vh z vi low | vl | low | high | high | low | vl | nb | vh | low | |
| vi night vi nb vii nb vii nb vl high vh wigh vii nb vii nb vii vl high vh vii nb vii nb vii low low high vh vii nb vii nb vii low low high vh vii nb vii low No obstacle in vicinity vl vl vii vii vii vii | vl | . 5 m | hiơh | 8" vh | hjøh | vl | nb | vh | low | |
| vi high vh vh high vi nb vh low low high vh vh high vi nb vh low No obstacle in vicinity vi vi vi vi vi vh z vi low | vl | low | | vh | hiơ h | vl | nb | vh | low | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | vl | high | vh | vh | high | vl | nb | vh | low | |
| No obstacle in vicinity vi vi vi vi | low | high | vh | vh | high | vl | nb | vh | low | |
| vl vl vl vl vl vh z vl low | No obs | tacle in | vicinity | | | · · · · | | | | |
| | vl | vl | vl | vl | vl | vh | z | vl | low | |