Rule change proposals for 2020

This document summaries the planned rule changes for RoboCup 2020. Teams are encouraged to give feedback and raise their concerns.

Feedback rules
The feedback must be well justified, not “feeling” based. “I do not like it” is not a justification. "Not like real soccer" is not a justification either. It has been discussed several times during trustee + EC meetings: It is okay, and encouraged to stray from human soccer rules if it improves AI, robotics and promotes better gameplay.

Major Game Play changes

Changes that have an impact on the actual game play.

Number of robots increased to 11 (DivA only)

Each team is allowed to play with up to 11 robots at a time, instead of 8.

The field size will not change (both Div)

We planned on doubling the field size for Div A again, if this is possible.
Doing so will increase the construction cost significantly, so we had a closer look at the field dimensions and area per robot:

field	width	length	area	robots	area/robot	notes
x1	4.0m	6.0m	24.0m²	12	2.0m²	
x2	6.0m	9.0m	54.0m²	12	4.5m²	Div B 2019
x2	6.0m	9.0m	54.0m²	16	3.4m²	
x4	9.0m	12.0m	108.0m²	16	6.8m²	Div A 2019
x4	9.0m	12.0m	108.0m²	22	4.9m²	
x8	12.0m	18.0m	216.0m²	22	9.8m²	

Even with 22 robots on the field, we still have more area per robot than in Div B right now. We are currently not seeing any strong advantage in doubling the field size again that would justify the additional costs.

Introducing walls into a subset of games (DivA only)

Most of the stops in 2018 and 2019 were due to the ball leaving the field. If we want to significantly increase the game-on time and decrease the stoppage time, we need to reduce the number of ball outs. Recent years have shown that the increased field size has no significant effect on the reduction of ball outs.

In 2020, there will be no ball out of play all around the field, except if both teams agree to play without walls. **Additionally, each team is required to play at least one match with walls during the group stage.**

The corners of the field will be rounded with a radius small enough that it does not disturb robots. The exact way of doing this is yet to be determined but could be one of:

1. ABS sheet nailed to edges to round corners
2. Have clipped corners so that corners are > 90 degrees
3. Machined (milled/printed) curved corner inserts

The goal will be recessed. There will be an additional set of goals that is attached to the field, if playing without walls. For simplicity, the field lines will be prepared for a game without walls, but will have no effect, if playing with walls (ssl-vision will send appropriate geometry).

Teams are explicitly encouraged to use the walls for doing passes. The walls will have a 90° angle and will not be damped. They will be equal or similar to the wooden walls used in previous RoboCups.

Having walls will not only reduce the number of stoppages, but will also offer new strategies, like passes via walls in the mid-field or smart attacks on the goal with the wall on the goal line.

There is the concern of getting stuck too often at the walls. There is currently not enough data to verify this concern, so we have to try it out. Feedback from local competitions is welcome.

Neutral restart with non-static ball (DivA only, only with walls)

With walls, the game might get stuck more often and a neutral restart is required.
But neutral restarts might get stuck again, if teams are not good at getting ball possession.

When looking at different sports competitions, many games with neutral restarts have motion: drop a puck, jumped ball or rolled ball.

We propose a neutral restart with a rolled ball: The referee rolls the ball in from the edge of the field, in a direction along the field.
There are fixed positions (e.g. middle of the field and two closer to the defense areas).
The ball will start at one of the fixed positions, closest to the last ball position.

Merge indirect and direct free kick into direct free kick (both Div)

There are only a few situations, where an indirect free kick is effective:

- Throw in -> large distance to goal, unlikely to score a goal directly anyway
- Attacker in defense area -> Even larger distance to goal

- Dribbling, ball speeding -> Rules will be changed such that the game is not stopped anymore

But it complicates things for:

- The [human|auto] ref: Has to decide what kind of freekick has to be issued
- The autoRef: Has to track indirect goals
- GameController (GC): Majority between autoRefs more complicated
- Teams: Have to distinguish free kicks (or they simply ignore it already)

We thus propose to merge both freekicks into direct freekick.

Fouls

Remove the double touch foul (both Div)

After free kicks and kickoffs, robots are not allowed to touch the ball a second time until another robot has touched the ball.
On the road to reducing stoppages, we propose to remove this constraint.
Double touch in the SSL often happens due to imprecision, not by intention. When the ball is moved, it is in play anyway, so all robots can touch it.
We want to encourage teams to work on dribbling balls (dribbling in the sense of small kicks, the 1m dribbling rule still applies) and the double touch rule rather counteracts this.

Lift the robot speed limit during ball placement (both Div)

The robot speed limit during stop is lifted for ball placement. As there is no human involved during automated ball placement, there is no need to reduce the speed limit.
The limit still applies to the regular stop state.

Reduce stoppages due to fouls (both Div)

Stoppages due to fouls should be reduced to an absolute minimum. For example, instead of stopping the game, we only increase the foul counter. The details for each foul are summarized here: Rule Changes for Fouls

Add a cost to timeouts (DivA only)

Timeouts waste time. Teams should be encouraged to reduce them to a minimum, while still being able to use them for serious issues.
We do not encourage teams to use timeouts for tuning their parameters.

The number and time of timeouts will not change, but after each timeout, the game will restart from a point in front of the team's defense area (at least 700mm) and with a direct freekick for the opponent team.

Ball going out of field (due to chip kick) (both Div)

Even with walls, the ball can still leave the field, if flying over the wall.
Teams should be encouraged to keep the ball inside the field, so there should be an adequate penalty for chipping the ball out.

If a teams chips the ball out, the foul counter of this team will be incremented.

If playing without walls, the game is restarted as if the ball left the field normally.
If playing with walls, the game is restarted with a free kick according to the current rules.

For simplicity, this change is not limited to games with walls.

Remove Penalty Kicks (both Div)

In 2019, there are two ways to receive a penalty kick:

- Every third card led to a penalty kick
- If a defender other than the keeper is fully inside the defense area and touches the ball

Penalty kicks have several disadvantages:

- They are quite unbalanced (and thus not very interesting)
- They lack innovation
- They need extra implementation
- They require additional time during a match
- They interrupt the game

We propose to get rid of penalty kicks completely:

- The Multiple Defenders foul will result in a red card. The game will be stopped immediately.
- The third **active** yellow card will be turned into a red card instead. A yellow card is active as long as the counter has not run out, so in order to get a red card, the team must collect three yellow cards within 2 minutes.

Do not bind cards to individual robots (both Div)

In the mail from September, we proposed to bind cards to individual robots. We decided to revoke the proposal.

The rationale behind this proposal was:
A yellow or red card goes to the robot that committed the foul. This punishes the team much more. It may need to remove a robot that works well, instead of choosing the weakest robot. If a team has less than the allowed number of robots on the field, it is not punished at all. It’s also more intuitive to the spectators.

There are several disadvantages, though:

- More complicated to track and to enforce (both human and autoRef)
- It would complicate the GC
- Especially hard for red cards
- Might reduce match quality, when teams have to use weaker robots
- Cards are mostly given for multiple fouls -> which robot to punish?
    - The foul counter leading to a card would also need to be individual, e.g. if a team has 10 fouls, but the robots that committed them only have two fouls each, that wouldn't result in any cards. In conclusion, only if a single robot commit three fouls it would receive a yellow card.
    - Team's could abuse this and use less/stop using a robot if it were close to receiving a card.
- Until robots are better identifiable for the spectators, it will not be more intuitive for them

We therefore postpone this proposal for 2020, but will consider it again later.

Secondary Changes

Limitations to Radio (both Div)

Mentioned in the mail from september already:
Teams will be limited to using only 2 rf channels (~4MHz) in the 2.4GHz band simultaneously at competition to ensure that we can provide non-overlapping channels to every team. 2.4 GHz Wifi will be disallowed. We are still investigating solutions for teams on 5GHz Wifi, but no decisions have been reached.
There are no updates to this yet.

Robot interchange during game play (DivA only)

We aim for less stoppages and especially with walls, there will probably be much less chances to interchange robots. We already encourage teams to automatically interchange robots by replacing them at the midline, but the game still had to be stopped and even halted in 2019. This wasted overall game time.

We propose that robots can always be taken in and out from the midline. No need to stop the game. There should not be any action at the midline during the replacement. That could be enforced by requiring that the ball is not near the interchange position.

Timeout required for manual robot interchange (DivA only)

In 2019, a lot of time was lost in HALT, while teams interchanged their robots.
We want to encourage teams to reduce the number of manual interchanges to a minimum and make use of the automatic interchange to save overall game time.

We propose that manual robot interchange (if the robot is not taken in/out from the midline) always requires a timeout to be taken.
If a team is out of timeouts and still needs to take one robot out, the team is allowed to take the robot out without a timeout, but can not use any remaining timeout time. It can only remove the robot from the field as fast as possible.

Do not stop game for yellow cards (both Div)

With the introduction of the autoRef, a lot more fouls were detected then before. This also results in more yellow cards, which in turn stop the game.

We propose to not stop the game on yellow cards immediately, but allow teams within 10s to move a robot to the interchange position, where it can be taken out immediately.
This is especially useful for bot crashes, which increase the foul counter, which in turn may add yellow cards.
If a team did not get a robot out within time, the game is stopped and the ball is placed in front of the teams defense area and the other team gets a freekick.

A team can't score a goal while having more than the allowed number of robots on the field.

Note: This rule change will also apply to DivB.

Tune Ball placement (both Div)

The ball placement procedure has some corner cases and can be optimized in speed.
There will be some optimizations, that have yet to be determined in detail:

- Relax the precision where possible
- Avoid ball placement at all, if the ball is already at a good position
- Be more strict with placement failures (turn it off faster)

Teams can decide to stop the game immediately (DivA only)

With less stoppages, there are fewer chances to get a robot from the field manually. Even with a timeout, the team would need to wait until the next stoppage.
If something goes really wrong with a teams robot (like damaging itself more and more), the team might want to stop the game to reduce the damage (and any cost due to destroyed parts).

Proposal: A team can ask to stop the game immediately after a grace period of 10s, regardless of the current situation. It will receive a yellow card for this and must take a timeout immediately. If the team is out of timeouts, it is still allowed to remove robots from the field as fast as possible, but can not use any remaining timeout time

Vision dropouts (both Div)

Robot detections from ssl-vision are not always reliable. We work on improving ssl-vision (new cameras, april-tags), but we cannot guarantee that detections will be stable at all times. Teams have to deal with vanishing robots as well.

We propose to stop the game only for catastrophic failures of ssl-vision, like camera failures. Teams have to make sure that the detections are good during their preparation time before the match starts and the game will not be stopped for vision problems afterwards.

We are aware that new teams may not focus on a good filter in the beginning, so they might have more difficulties with bad vision. There are several open-source filters available, though.
We'd like to establish a protobuf message that includes filtered vision data including velocities. An initial producer of this new message could be the autoRefs, which have filters and are open-source already.
We will not guarantee the availability of such a software, but we will do our best to make it happen.

Changing Keeper ID (both Div)

The keeper ID can be automatically changed with the team protocol which was introduced in 2019, but teams could only change the keeper during STOP.
This is an unnecessary limitation. With reduced number of stops, this becomes even more important.

We propose to allow changing the keeper id, as long as the ball is on the opponent's half. This applies to the team protocol as well as to the manual change via the game controller operator.

Challenge flag as in American Football (both Div)

In American football there is a challenge flag: A team can challenge a decision of the referee

- If referees decision was correct, team loses a timeout
- If referees decision was incorrect, correct decision is applied

Only one ruling may be challenged at a time.

We consider giving each team about two flags. The exact number is yet to be determined.

The rationale is that we are losing a lot of time discussing referee decisions. It will make teams think twice before discussing a situation.

Rule changes during competition (both Div)

We as TC/OC/EC try our best to come up with adequate rule changes that will improve the league. But there will always be an uncertainty that can only be clarified by actually running a competition. If we notice, during the competition, that some rule is not working out as expected, we'll open up the possibilities to adapt the rules:

- Between phases of the competition: Round-Robin / knockout / tournament
- Only invoked if we find major problems, **as a last resort**
- This is not an "out" for the rules making, to iron out details through regionals, testing, other avenues
- We will involve all team leaders into the decision

Communication Flags (both Div)

The human referee should be able to concentrate on the game. People yelling at him is not helpful, nor productive.

Each team should get a communication flag, to request both timeouts and challenges, similar to the flags for robot interchange in 2019.
The human referee has to acknowledge the communication flag. Any other communication, yelling, challenges, gesturing will be unsporting behavior: 1 warning and then red card(s).

Setup a Raspberry PI with Display and LAN cable and small UI per team (both Div)

We introduced flags to signal robot interchange in 2019. The feedback was mixed, though. It was hard for the GameController Operator to follow the game and have a look at the flags at the same time.

So instead, let's setup one PI per team with following features:

a. Activate/Deactivate timeout request
b. Change keeper id
c. Request robot interchange (signal team software to send out a specific robot during game play; in upcoming years, we may remove the possibility to specify the robot id to encourage teams to automatically detect failures)
d. Stop immediately

Teams somehow need to exchange robots that do not work well. This can not always be detected automatically. Keeping a damaged robot in play might damage it even more and might reduce the game quality (e.g. a robot that can not kick or that can not move well). With this "standard remote control", teams would be able to automatically interchange their robots without any game stoppage.
The protocol can be based on the team protocol introduced this year, so part of the work is already done.

We really want to implement this tool and replace the physical flags with it. We can not guarantee that this will be done in time. As always: Volunteers welcome.