The quotations refer to the latest version of the HL rule book (version of October 2012) available from http://www.tzi.de/humanoid/bin/view/Website/Downloads

The purpose of the robot design rules in the humanoid league is to ensure a "human-like body plan".

4 The Design of the Robots

Robots participating in the Humanoid League competitions must have a human-like body plan, as shown in Fig. 4. They must consist of two legs, two arms, and one head, which are attached to a trunk. The robots must be able to stand upright on their feet and to walk on their legs. The only allowed modes of locomotion are bipedal walking and running.

All actions of the robots must be kinematically equivalent to humanoid motions.

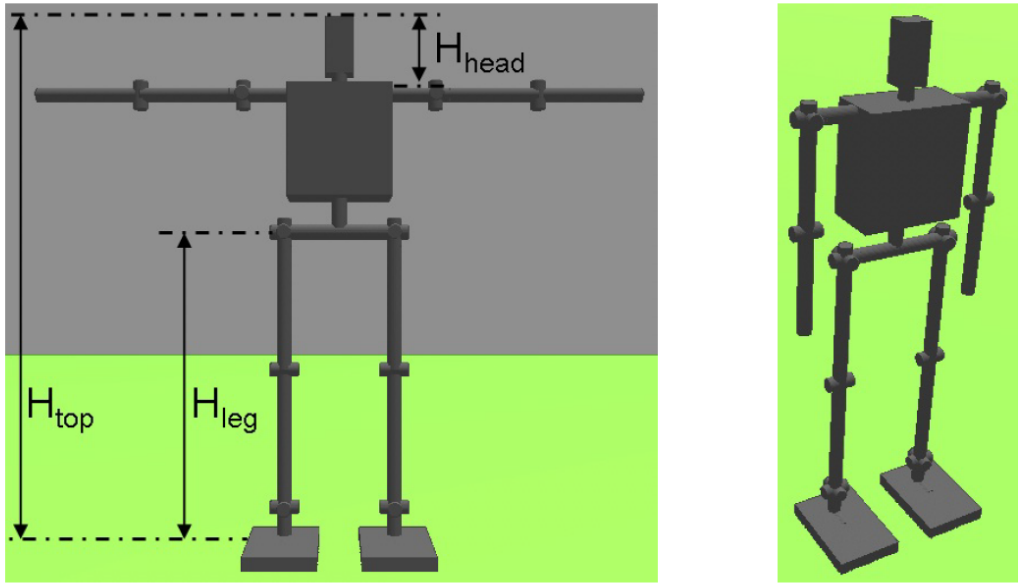

Figure 4: Example of a humanoid robot body plan (left) and standing upright pose (right).

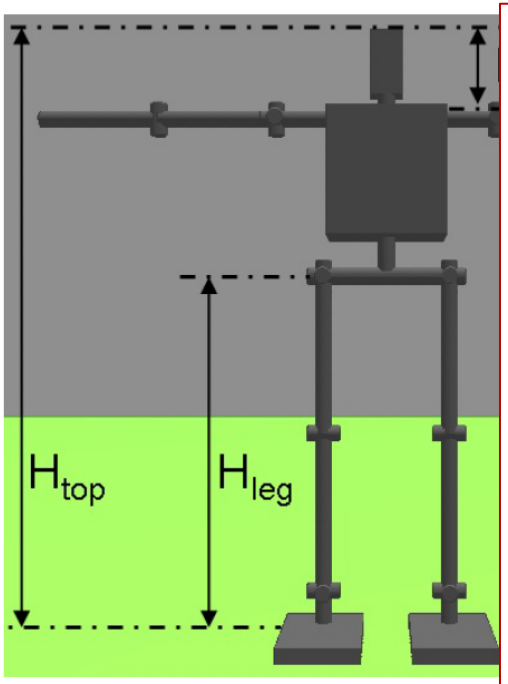

Figure 4: Example of a humanoid ro
(right).

Relation 4.1.1 was introduced for the first time in 2006 and used since then "as is". It links the kinematic robot height H_{top} to the distribution of mass by H_{com}. One goal of the design rules is to ensure "well proportioned" humanoid robots.

However, the factor 2.2 was set somehow in the past. A recent comparison with human data reveals that the corresponding relation in average human adults is

$$H_{top} = 1.82 \times H_{com} \quad (\text{resp. } H_{com} = 0.55 \times H_{top})$$

see http://hypertextbook.com/facts/2006/centerofmass.shtml

Proposal 1: Change 2.2 to correct factor 1.82 for human-like proportions. And check the cross effect on other dimensions for arms, heads etc.

4.1 Robot Height

4.1.1. The height H of a robot is determined as follows:

$$H = \min\{H_{top}, 2.2 \cdot H_{com}\}, \qquad (1)$$

where H_{top} denotes the height of the robot when standing upright (with fully extended knees, cf. Fig. 4 right) and H_{com} denotes the height of the robot's center of mass, measured in upright posture.

The purpose of the size restriction for maximum foot size (4.3.1) is
(i) to foster the development of dynamically walking humanoid robots and
(ii) to have equal challenges for robots of different size in the same HL subleague.
Regarding the challenge for dynamics and postural stability of walking, H_{com} is crucial and H_{top} is irrelevant. However, as the current maximum foot size definition is based not on H_{com} alone but also on H_{top} through 4.1.1, this gives robots with human-like proportions a clear disadvantage because of the factor 2.2 (see also the following example).

4.3 Size Restrictions

All robots participating in the Humanoid League must comply with the following restrictions:

1. Each foot must fit into a rectangle of area ~~$H^2/30$~~ $H^2/32$.
2. Considering the rectangle enclosing the convex hull of the foot, the ratio between the longest side of the rectangle and the shortest one, shall not exceed 2.5
3. The robot must fit into a cylinder of diameter $0.55 \cdot H$.
4. The sum of the lengths of the two arms and the width of the torso at the shoulder must be less than $1.2 \cdot H$. The length of an arm is defined as the sum of the maximum length of any link that forms part of the arm. Both arms must be the same length.
5. The robot does not possess a configuration where it is extended longer than $1.5 \cdot H$.
6. The length of the legs H_{leg}, including the feet, satisfies $0.35 \cdot H \leq H_{\text{leg}} \leq 0.7 \cdot H$.
7. The height of the head H_{head}, including the neck, satisfies $0.05 \cdot H \leq H_{\text{head}} \leq 0.25 \cdot H$. H_{head} is defined as the vertical distance from the axis of the first arm joint at the shoulder to the top of the head.
8. The leg length is measured while the robot is standing up straight. The length is measured from the first rotating joint where its axis lies in the plane parallel to the standing ground to the tip of the foot.

Example for Humanoid KidSize

Example Robot 1: H_{top} = 60cm, H_{com} = 28 cm

The maximum allowed foot size according to 4.3.1 is $60^2 / 32$.

Example Robot 2: H_{top} = 60cm, H_{com} = 33 cm

The maximum allowed foot size according to 4.3.1 is $60^2 / 32$.

Both robots have the same maximum allowed foot size, but for robot 2 with human-like proportions (i.e. H_{top} = 1.82 x H_{com}) the challenge of postural stability is made much more difficult.

Current rule 4.3.1 handicaps robots with human-like proportions. It also discourages the development of better proportioned humanoid robots.

Both effects are not in line with the overall purpose of the humanoid robot design rules.

Proposal for temporary rule fix for 2013

- Should weaken the disadvantage for robots with human-like H_{com}.
- Should otherwise have as small as possible impact on all other parts of the rules.

Proposal 2:

- Replace $H^2/32$ by $H_{com}/32$

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