Ruf Ruf Dougal

Robot Wars Series 5

Peter Sturgess C.Eng

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Design Principles

1. **Challenge the norm….**
2. **KISS Keep It Simple, Stupid….**
3. **Being defensive only gets you a second place…..**
4. **Any fool can do for £100 what an ‘engineer’ can do for nowt….**
5. **Just because everybody else say’s it’s the best way doesn’t mean it is….**

The Concept

Robot Wars has a big following amongst both young children and their parents. It was decided to build a robot that would visually appeal to both age groups. The solution was to base it on the Magic Roundabout character ‘Dougal’. Being a cuddly dog would appeal to the younger viewers whilst their parents would remember his character as the bossy dog who pushed everyone around at the end of kids TV every evening.

The shape of Dougal is ideally suited to being robotised and his distinctive spinning, whilst not in the ‘Chaos 2’ league is easy to replicate in a differential drive robot.

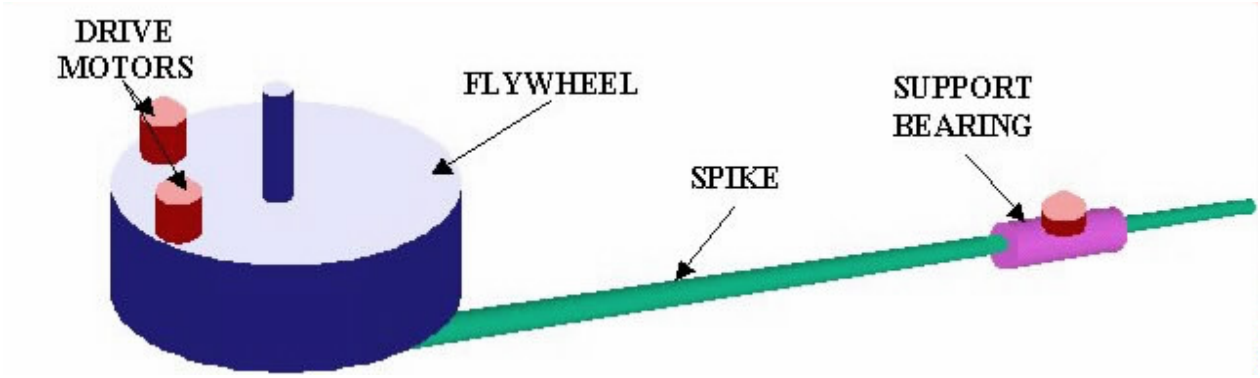
Engineering Ideas -

Weaponry

To my knowledge the only successful robot that has used an inertia weapon has been ‘Hypnodisc’. Whilst this has been very successful it is time to move the concept on, to make better use of flywheel energy.

Flywheels, as has already been proved, produce massively destructive inertia forces but this can by harnessed in different ways to ‘Hypnodisc’ to give additional benefits.

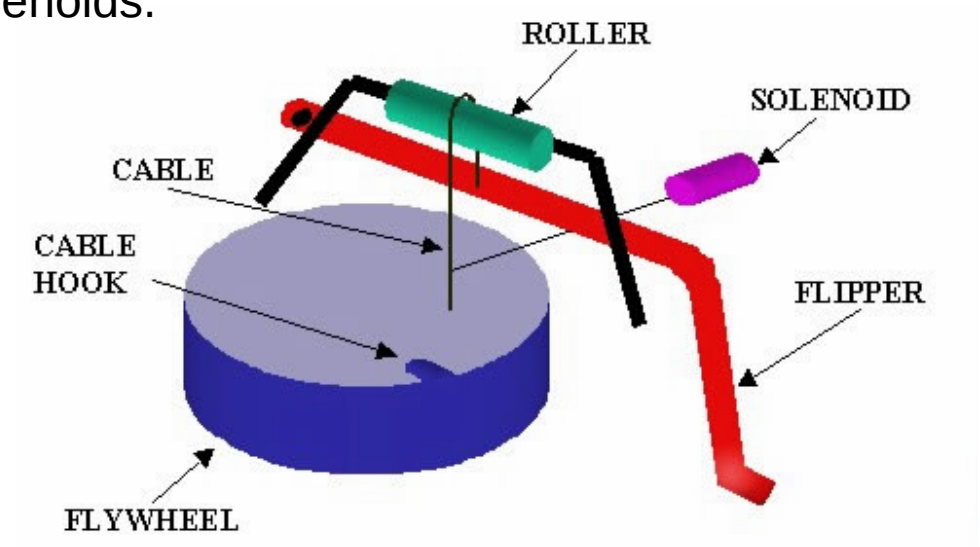
‘Dougal’ will use an internal flywheel which directly drives a constantly running spike of adjustable height. The spike will be camouflaged to look like Dougal’s little red tongue! Inertia produces the destructive forces much more quickly that a hydraulic or pneumatic system, takes very little energy and does not have a limited number of strikes.



Engineering Ideas

– Weaponry – cont.

Dougal will also have two side mounted flippers (legs) which have a geometry based on ‘Chaos 2’ These will be both offensive weapons and defensive Srimechs. They will be actuated in a similar way to jet engine fuel cut offs, by firing a cable onto a hook in the spinning flywheel. Left and Right flippers will have independent control and be actuated using car starter motor solenoids.



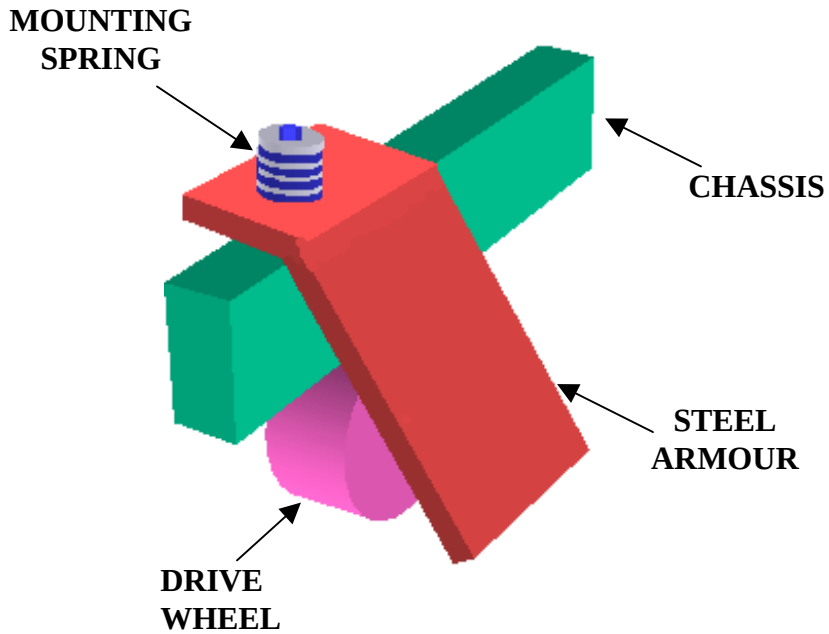
The spinning flywheel will also produce a gyroscopic stabilising force in the centre of the robot to reduce the possibilities of being flipped by inertia flippers. It’s sharpened edge would cause damage to under run wedge robots.

Engineering Ideas -

Armour

Being a defensive robot can, at best achieve second place since the point of Robot Wars is to attack. Therefore Dougal will have lightweight strategic armour which is designed to combat different weapons based on its position on the robot.

The chassis will be set at a high level with only the flywheel and drive wheels below 150mm. This will reduce the risk of damage from floor spikes or axes if overturned. The distinctive shape of Dougal's body will be achieved using corrugated steel from the chassis height down to the ground. This armour will be spring loaded to reduce the impulse force of flippers and allow high speed wedges to pass underneath to be cut by the flywheel.



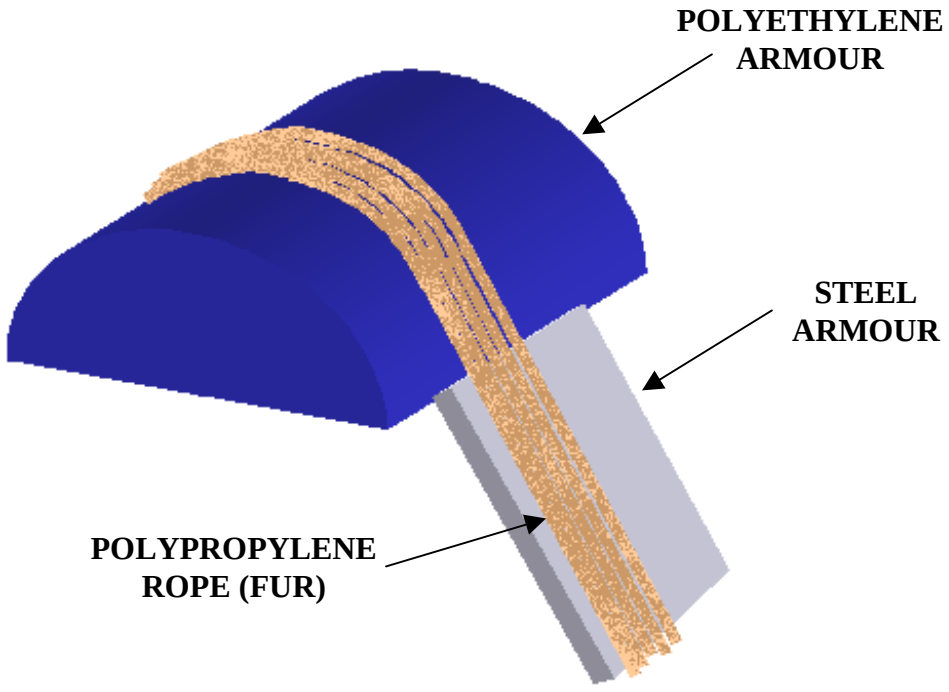
Engineering Ideas -

Armour – cont.

Above chassis height the armour will be polyethylene since this is lightweight, will deflect without damage and has good impact properties in its own right.

The polyethylene will be covered with a flame proof fabric (ironing board cover).

In order to make the robot look like Dougal the outside of his body will be covered in polypropylene rope. This should also counter attacks from cutting blades since the rope could jam rotating shafts.



Dougal's head will be made from an old motorcycle crash helmet with the tongue spike emerging at the bottom.

Engineering Ideas –

Drive System

In order to spin on his own axis like the real Dougal the robot will need to have two wheel differential drive centrally mounted. To gain maximum tractive effort these wheels must carry all the weight of the robot and be able to transfer that load into the road surface through high friction tyres. Obviously this cannot be achieved in practice but the weight distribution will be optimised for highest traction.

Transferring the torque to the road surface in the best way depends on the road surface. Dougal will be equipped with two types of tyre, the first will be conventional solid rubber tyres which have been surface machined. These will be used on metal, concrete or tarmac surfaces. The second will be made from industrial rotary wire brushes with 32 SWG bristles. These will be used on wooden or oily surfaces.

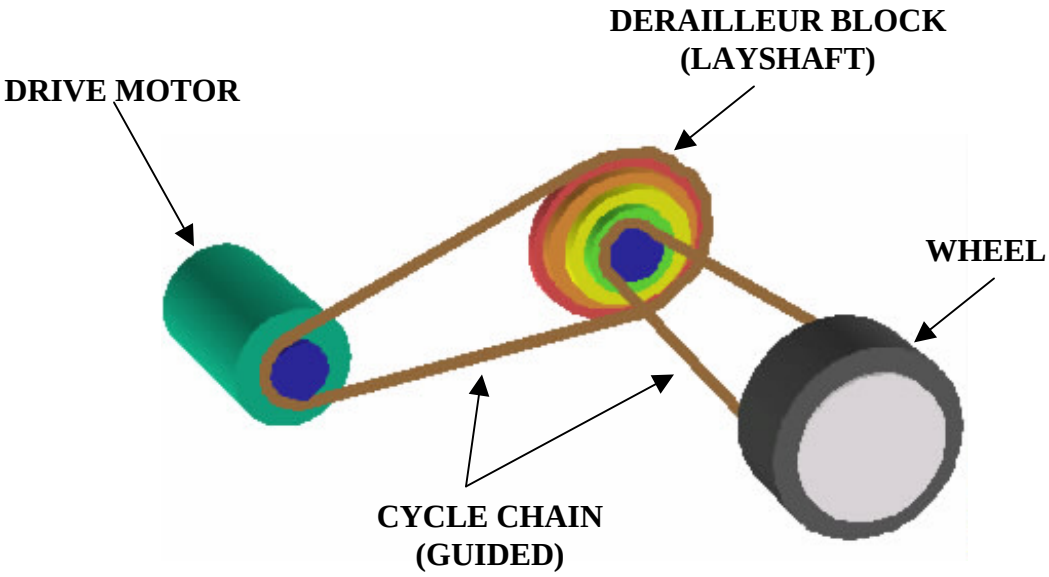
Wire Wheel to be used as a drive wheel on wooden floors

Engineering Ideas –

Drive System – cont.

Drive will by Japanese electric motors, these motors are rated at 12V 60A with a no load speed of 1700rpm. They have a friction clutch included set at 9Nm. Overrunning the motors at 24V produces a confirmed speed of 3400rpm but does not increase the maximum current demand above 130A since the clutch controls the torque.

The chain drive will use a ratio of 3.27:1 and with ø125mm drive wheels this produces a maximum forward speed of 15mph and a tractive force of 940N



Engineering Ideas –

Control System

The drive motors will be controlled by two 4QD NCC-70-24 motor controllers with a DCI-111 dual channel interface in independent mode.(cheaper than 2 independent interfaces).

The radio system will be a 7 channel Multiplex Cockpit MM with an IPD receiver to control the servos and act as the failsafes. This system has been proven to be rugged from an interference point of view and also has the control performance of other PPM systems. The additional cost of the radio kit should be offset be deleting the requirements for separate failsafes. Also the reduction of wiring complexity on board should improve reliability and reduce the risk of damage.

The flywheel will be the energy source for all weapons and will be driven by 2 Bosch ABS motors to give system redundancy. They will be relay switched without speed control.

Timing Plan

The plan is to finish the Robot for the third week in June to allow enough time for driving practice and tuning. This will however depend on other time commitments, the supply of purchased equipment:- motor controllers, radio gear etc and the availability of scrounged parts (almost complete).

Budget

Most of the mechanical components have been blagged or purchased from scrap yards or boot sales. The big expenditure is going to be radio gear and motor controllers. I'm still hopeful to acquire batteries but failing that I hope Bull Electronics still have Micro Kiels available. I'm hoping that I can limit 'on robot' expenditure to about £600 but of course that does not include tools, consumables, travel etc.

In House Facilities -

Fabrication

Workbench
Vice
Bench Grinder
Angle Grinder 5”
Angle Grinder 9”
Blacksmiths Anvil
MIG Welder 100A
Arc Welder (Oil Cooled Industrial)
Propane Torch
Power Drill
Jigsaw

Machining

Lathe – Boxford
Lathe – Colchester
Pillar Drill – Herbert
Shaper

Electrical

Avo Mk 8 Multimeter
Clip Round Ammeter
Oscilloscope
Soldering Iron

The Team

Lorna on MZ ES150

Peter Sturgess (Team Captain) is a Chartered Engineer and is a Design Manager for Honda R&D. He is married with a four year old daughter, Lorna. He's a 'hands on' engineer whose hobbies of old motorcycles, caravanning and horse riding keep him busy when his daughter allows!

Martin Sturgess is a fully trained welder and fabricator more used to welding fuel tankers than robots. He is married with 2 dogs, 3 cats and a horse, which he follows on a bicycle whilst his wife rides!

One of Martin's early projects

He spends his time restoring a beautiful old house and dreaming about fixing up his old Jaguar cars.