Among the student teams of the Delft University of Technology there is one team that takes it up against professional, non-student teams on a European level: green fuel versus fossil fuel, at full speed on a racetrack. The NovaBike Racing Team Delft designs, produces and races motorcycles which run on second generation bio-ethanol. The third bike, NovaBike03, is being built this year, and will compete in the European Supermono Championship and try to set the world speed record for bio-ethanol motorcycles. Discover the dynamics simulations, aerodynamics, and location and communication system of NovaBike03 in this article!

VEHICLE DYNAMICS SIMULATIONS
(by Malte Verleg)
This year the focus lies on making vehicle dynamics simulations of NovaBike02 so that valuable time can be put into the improvement of the current geometry rather than starting anew. The simulations are done in MATLAB, Adams and eventually VI Motorcycle. The suspension is analyzed with simulations of models which represent the rear and front suspension, allowing it to be adjusted on a theoretical basis. With these models, the change in the driving behavior can be analyzed by changing parameters such as the pre-loading of the springs and the compression and rebound coefficients of the dampers. An example of a simulation can be seen in Figure 1; the model is simulated with a small step input, with in this example, a variable spring stiffness. Depending on the design requirements and desired behavior a required spring stiffness can then be chosen. Another goal is to match the suspension to the rider’s preferences as closely as possible, because he has to feel confident with the bike in order to go fast around the track. Therefore rider feedback is very important to verify the changes made based on theory.

Randy van der Wal (test rider for Motor Magazine) is the rider for this year. His extensive experience and competitive driving make him perfectly suited for this team. An additional benefit is that full race reports will be published in Motor Magazine throughout the season!

BODYWORK
(by Ron de Vries)
Designing a new bodywork for the NovaBike03 is a challenging assignment. A lot of disciplines come together in the design since the bodywork has several overlapping and secondary functions. Functions include rider protection, rider support (seat), a crisp appearance, a sponsor “canvas” and, most importantly, provide the motorcycle with good aerodynamic properties. At high speeds, approximately 90% of the engine power is used to overcome aerodynamic drag. Therefore there is a point where higher speeds are more easily achieved by improving the motorcycle’s aerodynamics rather than adding horsepower.

In general, a (not fully faired) motorcycle has bad aerodynamic properties due to the fact that the fairing has no continuous shape. For analysis of aerodynamic drag, the fairing is divided into sections. The frontal zone is most relevant when it comes to lowering the total drag. Its most important function is guiding the air around the rider and engine parts. Using CFD analysis the team is currently analyzing different shapes of the front fairing.

The mid zone, which is largely covered by the rider, generates a significant contribution to aerodynamic drag. This is because there are empty spaces between the fairing and the rider, which results in a large part of the flow becoming turbulent. Un-
fortunately this cannot be avoided since the rider has to be able to move freely from one side to the other.

The rear zone has to be designed so that the wake is as small as possible. For NovaBike03 this has little aerodynamic influence since regulations prescribe a maximum size and position of the seat, and aft part of the motorcycle body. As a larger size is beneficial, the aerodynamics cannot be significantly improved within the confines of the regulations. However the design of the rear body, which is a carbon fiber monococque structure, has an influence on the total weight. Therefore the rear body is designed to be as light as possible, using a structurally efficient shape.

In order to realistically compare the aerodynamics of the different motorcycles, the Cd*A value is used, which is the product of the drag coefficient and the frontal surface area. A wind tunnel test was performed at the Open Jet Facility of the faculty of Aerospace Engineering, as can be seen in Figure 2. Among other things, it showed a twenty percent decrease in Cd*A value of NovaBike02 (with rider) in relation to NovaBike01 (with rider).

The goal for the NovaBike03 bodywork department is to make the body even lighter and lower the aerodynamic drag while remaining an attractive and crisp looking motorcycle. Some concepts that are currently being explored are a smaller air-box intake, frontal flow separation and a new sandwich structure for the monococque seat.

THE LOCATION AND COMMUNICATION SYSTEM
(by Jeroen Kruit)

Work is also being done on a GPS tracking system and a wireless communication system to study and improve the driver's behaviour on the track. Even though transmitting information is not allowed during a race, it is allowed during training sessions. Based on the gathered data, feedback can be given to the rider, hopefully resulting in quicker lap times.

The system will use a frequency bandwidth of around 900MHz with an output power of one Watt. With this device it should be possible to send and receive information from any position on the track. The maximum obtainable data rate will be 115.2kbps, which is sufficient for communication. Next to studying the driver’s behaviour, the GPS data will also be used to improve the gearshift indicator, a device that indicates when it is optimal to shift gears. In regular gearshift indicators, this point is only dependent on the rotational speed (RPM) of the engine and is set at a fixed value. With the help of GPS data, this value can be adjusted depending on the track location, so the engine can anticipate the driver's behaviour and will therefore complement the driver's intentions.

The accuracy and the refresh rate of the GPS location are of course crucial in making the system reliable. There are products available which provide high position accuracies and a high refresh rate, but this comes with a significant price tag. A typical GPS module will have a refresh rate of one Hertz and an accuracy of at best 2.5m. These modules are very cost efficient, though they will not give us the proper results to analyse. Just as a comparison: a GPS module which has a refresh rate of twenty Hertz and an accuracy of at best two centimetres, will be a thousand times more expensive and you will end up buying two GPS modules instead of one to obtain such a high accuracy (in most cases). Therefore, a proper choice of the required accuracy and refresh rate is essential to keep the component cost as low as possible. In addition, the total energy consumption should be as low as possible since this determines the required battery capacity and thus weight.

Luckily, Racelogic is willing to provide one of their products: the Video V-Box Pro (see Figure 3). This system has a GPS receiver and two external cameras. The GPS receiver has a refresh rate of ten Hertz and a minimal accuracy of 5m. The camera recordings will be used to evaluate the driver's behaviour so they can go faster around the track, lap after lap.

Our race season starts on the 7th of April at the TT circuit in Assen, so keep an eye on our website (www.nova-bike.nl) or follow us on facebook.com/NovaBike or on twitter.com/NovaBike. The World Speed Record event will probably take place after the summer. If you are interested, consider joining the team, new members are always welcome. You can participate part-time during your study programme, full-time or as DREAM minor student. Do not hesitate to contact us via info@nova-bike.nl!