Few projects exemplify UCSB’s core belief in applied research and environmental responsibility better than the supermileage vehicle project. Born only 4 years ago, the UCSB supermileage team is becoming a worthy competitor in the annual Shell Eco-Marathon Competition, where the vehicle with the best miles per gallon wins. Last year’s team competed at the Fontana Speedway in Fontana, California, achieving an estimated 765 mpg, but could not complete any runs due to gearbox failure. This year the team’s project was to design a new, more robust gearbox, as well as make various other improvements, in order to improve gas mileage and prevent mechanical failure at this year’s competition in the streets of downtown Houston, Texas.

The main focus of our project was redesigning and replacing the failed drive train system. Auxiliary goals included reducing rolling resistance, improving robustness and maintainability as well as reducing vehicle weight. The culmination of this work was improved vehicle fuel mileage and reliability at competition. Calculation of failure conditions led to the design of a new mounting configuration, leaving the vehicle’s standard bolt size unchanged. The overall drive configuration was switched from left hand drive to right hand drive to minimize unwanted forces by dramatically shortening shaft lengths in the gearbox, reducing internal moments by 118.3 lb-ft. CAD models and engineering prints were made for every aspect of the gearbox. A working prototype with identical, interchangeable internals and full bill of materials was made for easy replacement of gearbox components.

At the Shell Eco-Marathon our vehicle performed efficiently and reliably, fulfilling our main goals. We were able to complete 6 official runs while experiencing minimal problems. Our official mileage was 735 mpg, earning us 20th place out of 44 teams. Although we did not improve upon last year’s mileage, we were able to match the previous mpg rating to within 4%. An impressive result considering the previous rating was attained on a professional speedway while this year’s rating was achieved on a street course with sharp turns and less than ideal road conditions. After competition the gearbox was examined, showing no signs of wear. These results suggest an more reliable and efficient vehicle, and prove the robustness of the new transmission system.

Other improvements:

- Cleaned up wiring
- Cleaned up fuel/air tubing
- Reduced rear wheel rolling resistance
- Custom wheel, hub, and mounts
- New gearbox mounts
- New radiator mounts
- Reduced weight (122 lbs to 115 lbs)
  - Smaller battery
  - Steering improvements
  - Steering damper
  - New driver handles and switches

The gearbox takes input from the CVT pulleys and features a single ratio gear reduction. The gears are submerged in oil to ensure smooth and reliable operation. The lightweight housing is machined from aircraft grade aluminum and is hollowed out to minimize weight. Key features include:

- Transfer max engine power through the gearbox without shearing the key ways
- Gearbox reduction ratio of 3.4:1 from input to output shaft
- Gearbox withstands engine input of 8000 rpm
- The clutch does not engage below idle speed of 2000 rpm
- Gearbox mounts withstand an output shaft force of 1500 N
- Use existing CVT in new drive train

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