Computer simulation of power balance of a solar vehicle depending on its parameters and outside factors

G. Frydrychowicz-Jastrzębska[1], E. Perez Gomez[2]

[1] Poznań University of Technology
Institute of Industrial Electrical and Electronical Engineering
Piotrowo Street 3a, 60-965 Poznań (Poland)
e-mail: grazyna.jastrzebska@put.poznan.pl
Phone, +48 616652388, fax, +48 616652389

[2] Universidad de Politecnica de Cartagena
30202 Cartagena, Plaza del Cronista Isidoro Valverde - Edificio La Milagrosa (Spain)
e-mail: sinuhedu@hotmail.com

Abstract. The paper presents simulation of steady motion of a solar vehicle supplied with solar energy directly from a panel and indirectly from a battery. Analysis of power distribution has been carried out, inclusive of the power demand related to the need of overcoming rolling and aerodynamic resistance with respect to its structural and operational parameters and parasite losses and with regard to geographic location, hourly distribution of insolation on recommended days of selected months, spatial arrangement of the panel, aided by an accumulator battery.

Key words

solar power, photovoltaic panel, battery charge, solar car, Trans - Australian World Solar Challenge Race.

1. Introduction

Solar cars are reckoned as automotive vehicles driven by electric energy obtained as a result of photovoltaic conversion [2, 5, 6, 7, 9, 13] In order to use the module as a power source a power accumulator should be connected to it [2, 3, 5, 12].
Low power consumption is very important in case of solar vehicles Therefore, they should be characterized with low mass, low value of the rolling resistance coefficient, and - aerodynamic shape [2, 7, 9, 13] that is shown in Fig.1.

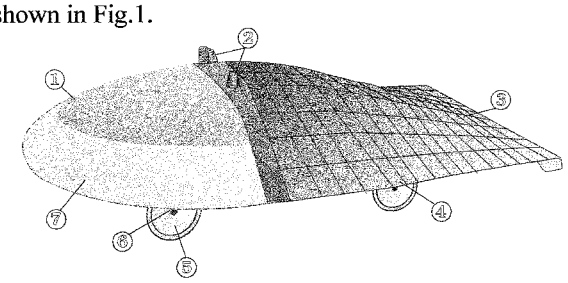

Fig.1. Solar car "Sunraycer", plexiglass windscreen covered with gold (1), stabilizers (2), solar batteries (3), rear drive (4), plastic wheels discs (5), body reinforcement (kevlar) (6) [9]

The requirements imposed on the vehicles supplied with solar energy include among others [1, 2, 3, 5, 6, 7, 8, 9, 13]:
- monoposte composite car body optimized to light weight and little air resistance, Table 2,
- construction form supporting fiber reinforced body structure, a shell of body on layer lamination, strengthening ribs in sandwich construction (a little aerodynamic coefficient),
- special solar car tires with a little coefficient rolling resistance,
- solar generator - highly efficient solar cells (Table 2), enclosed in ultra- lightweight glass - fiber reinforced plastic,
- highly efficient solar Maximum Power Point Tracker (98 - 99 %), [3, 9, 10, 11].
- synchro - motor with magneto - pernament, efficiency 95 - 98 % [13] ,
- battery with highly efficient and capacity (li-ion, li-polymer, zinc-air), 80 - 95 % [13],
- instrument of panel and drive units controls 97 % [8].

2. Participans of Solar Challenge Race

Twenty four entries from the seven countries cited starting in the Trans - Australian World Solar Challenge Race in year 1987. The winner, Sunraycer, shown in Fig.1. is a solar car designed in 1987 by General Motors. This is a one - seat and four - wheeled car. Sunraycer built on an aluminium tube space - frame (weight with a driver ballasted 248 kg) [13]. It won the Trans-Australia World Solar Challenge Race, travelling the route with the velocity of 70 km/h [9, 13]. In this vehicle the monoctrystalline silicon solar cells have been used, with an electric motor of 1,5 kW, and silver-zinc batteries.
Figs. 2, 3, and 4 shows solar cars - which took part in Trans-Australia World Solar Challenge Race, in year 1999. Only 28 of vehicles out of 40 starting in this have finished the race [13].

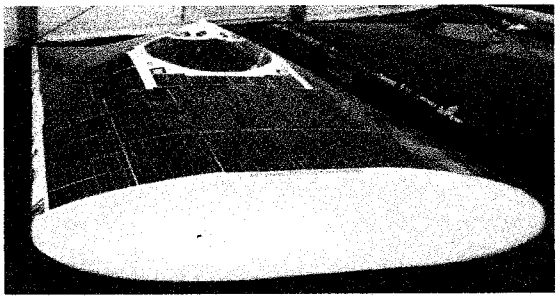

Fig.2. Solar car Manta GTX, 8-th plays [9]