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INVESTIGATION THE SENSITIVITY OF THE MOTOR VEHICLE DYNAMIC SYSTEM

In this study, possibilities for using sensitivity functions in the time and frequency domain, for analysis the vehicle dynamic system, have been considered. Certain advantages of the mentioned analysis in frequency domain are emphasized because, the same refer directly to the sensitivity of the system structure, independently of the form of the excitation.

Analysis of the recently issued studies from this field pointed to the actual problems concern procedure for creating model of the vehicle, determination the function of the sensitivity as well as establishing the adequate criterions for accessing the results. Only for simplified model of the lateral dynamics of the vehicle, sensitivity functions have been determined in frequency domain, with the help of algebraic methods. For the degree of freedom vehicle model, with the larger number of system parameters, it's necessary to form algorithms of the more complex numerical methods with the aim to perceive sensitivity of the system to the changes of the parameters.

During this process, it's very rare to find results of the system sensitivity analysis to the changes of the driving parameters and their connection with design parameters.

In our former studies, we pointed to the above reported problems. When we formulated the sensitivity function of the vehicle dynamic system in this study, we had in mind complex interaction between design parameters of the vehicle, vehicle speed and frequency of turning the steering wheel.

Model of passenger car has been created, with transfer structure described with 7 differential equations, 44 konstruktive and 2 driving parameters. Structure and parameters of the model were verified in our former experimental investigations.

For computer calculations we used improved method of algebraic inversion of the system matrixes. Transfer functions of the yaw velocity and the lateral acceleration were determined.

Also, values of the corresponding functions of the sensitivity were calculated in relation to the turning frequency of the steering wheel and vehicle speed, as driving parameters.

Obtained calculation results of the sensitivity function offer new possibilities for the analysis as well as for the interpretation the transfer functions of the vehicle lateral dynamics.

Key words: Vehicle handling, dynamic system, sensitivity function, system parameters, frequency domain.

ISTRAŽIVANJE OSETLJIVOSTI DINAMIČKOG SISTEMA MOTORNOG VOZILA

U radu su razmotrene mogućnosti korišćenja funkcija osetljivosti u vremenskom i frekventnom domenu za analizu dinamičkog sistema motornog vozila. Istaknute su određene prednosti ove analize u frekventnom domenu, jer se analiza odnosi direktno na osetljivost strukture sistema, nezavisno od vida pobuđivanja.

Analizom novijih radova iz ove oblasti ukazano je i na aktuelne probleme vezane za proceduru formiranja modela vozila, određivanja i utvrđivanja funkcija osetljivosti i kao i na utvrđivanja adekvatnih kriterijuma vrednovanja rezultata. Samo za uprošćene modele bočne dinamike vozila određene su funkcije osetljivosti u frekventnom domenu uz pomoć algebarskih metoda. Za modele vozila višeg reda, sa većim brojem konstruktivnih parametara, neophodno je formirati algoritme kompleksnijih numeričkih metoda u cilju praćenja osetljivosti sistema na promene parametara. Pri tome se veoma retko sreću rezultati analize osetljivosti sistema na promene eksploatacionih parametara i njihove sprege sa konstruktivnim parametrima.

U naćim ranijim radovima ukazali smo na izložene probleme. Pri formulisanju funkcija osetljivosti dinamičkog sistema motornog vozila, u ovom radu, imali smo u vidu kompleksnu interakciju konstruktivnih parametara vozila sa brzinom kretanja i učestanošću zaokretanja toćka upravljaća. Formiran je model putnićkog automobila prenosne strukture opisane sa 7 diferencijalnih jednaćina, 44 konstruktivna i 2 eksploataciona parametra. Struktura i parametri modela verifikovani su u našim ranijim eksperimentalnim istraživanjima. Za kompjuterske proraćune korišćena je poboljšana metoda algebarske inverzije polaznih matrica sistema. Ođređene su frekventne karakteristike po ugaonoj brzini zaokretanja vozila oko vertikalne ose i po boćnom ubrzanju težišta. Preraćunate su vrednosti odgovarajućih funkcija osetljivosti u odnosu na učestanost zaokretanja toćka upravljaća i brzinu kretanja vozila. Dobijeni rezultati proraćuna funkcija osetljivosti prućaju nove mogućnosti analize i interpretacije prenosnih odnosa boćne dinamike motornog vozila.

Ključne reći: upravljivost automobila, dinamićki sistem, funkcija osetljivosti, parametri sistema, frekventni domen.