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Pregledni članak

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NELINEARNE POJAVE U ENERGETSKOJ ELEKTRONICI

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Nedavno je otkrivena nova vrsta pojava na području dinamike nelinearnih sustava. Novi pojmovi i nazivi zamijenili su vremenske funkcije i frekvencijske spektre u opisivanju njihovog ponašanja. U rječnik su uvedeni nazivi kao što su: kaos, bifurkacija, fraktal, Lyapunov koeficijent, period udvostručavanja, Poincaréov dijagram, nepoznati atractor, itd. Osnovni cilj članka je dati pregled sadašnjeg stanja napredne teorije nelinearnih dinamičkih sustava. S tri primjera ilustrirana je njezina primjena u energetskoj elektronici.

(Sl. 28, Tabl. 2, Lit. 35 – original na engleskom) *Autor*

dinamika nelinearnih sustava
teorija kaosa
putevi u kaos
geometrija fraktala
učinska elektronika

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Pregledni članak

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EVOLUCIJSKI ALGORITMI (II) – PRIMJENA

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U tekstu je prikazan primjer praktične primjene evolucijskih algoritama (kratica EA). Prikazano je evolucijskom strategijom potpomognuto ugađanje parametara PID regulatora primijenjenog na procesu izmjene topline. U nastavku teksta navedena su glavna područja uspješne primjene evolucijskih algoritama. Za one koji žele saznati više o području evolucijskih algoritama na kraju su navedeni korisni izvori informacija, kao i udruge koje okupljaju EA istraživače.

(Sl. 4, Lit. 51 – original na hrvatskom) *Autori*

evolucijski algoritmi
evolucijske strategije
primjena evolucijskih algoritama
izvori informacija evolucijskih strategija

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EVOLUCIJSKI ALGORITAM TEMELJEN NA OFF-LINE PLANERU PUTANJE ZA NAVIGACIJU BESPILOTNIH LETJELICA

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Predstavljen je off-line planer putanje za bespilotne letjelice. Planer je temeljen na evolucijskim algoritmima za proračun zakrivljene putanje sa željenim karakteristikama u 3D prostoru. Putanja je predstavljena pomoću B-spline krivulja, gdje su koordinate kontrolnih točaka geni umjetnih kromosoma evolucijskih algoritama. Metoda je provjerena na umjetnom 3D prostoru s različitim početnim i konačnim točkama, gdje su dobivene vrlo glatke putanje uz zadovoljenje strogih ograničenja.

(Sl. 9, Lit. 6 – original na engleskom) *Autori*

B-spline
3D planiranje putanje
evolucijski algoritmi
navigacija
UAV

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KONVEKSNA OPTIMIZACIJA U UČENJU CMAC NEURONSKIH MREŽA

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Jednostavnost građe i algoritama učenja od iznimne su važnosti u primjenama neuronskih mreža u stvarnom vremenu. CMAC neuronska mreža s asocijativnom memorijskom organizacijom i Hebbianovim algoritmom učenja udovoljava ovim zahtjevima. Međutim, Hebbianov algoritam učenja ne daje dobre rezultate pri off-line identifikaciji, koja se koristi kao pripremna faza za on-line identifikaciju.
U ovom se članku pokazuje da se optimalne vrijednosti parametara CMAC neuronske mreže mogu dobiti primjenom tehnika konveksne optimizacije. Za standardnu l_2 aproksimaciju koristi se kvadratno programiranje (QP), a za l_1 i l_∞ aproksimacije linearno programiranje (LP). U oba je slučaja jednostavno uključiti fizikalna ograničenja na vrijednosti parametara u algoritam optimizacije.

(Sl. 9, Tabl. 2, Lit. 13 – original na engleskom) *Autori*

CMAC neuronske mreže
identifikacija
konveksno optimiranje
kvadratno programiranje
linearno programiranje

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Review

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EVOLUTIONARY ALGORITHMS (II) – APPLICATION

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The paper gives an example of practical application of evolutionary algorithms (EA). There is also an example of heat exchange process controlled by PID controllers. PID controller parameters were adjusted by means of evolutionary strategies. Further, the text mentions main fields of successful appli-cation of evolutionary algorithms. For those wanting to learn more about evolutionary algorithms, sources of useful information and EA research organizations are listed at the end.

(Fig. 4, Ref. 51 – original in Croatian) *Authors*

evolutionary algorithms
evolution strategies
evolutionary algorithm applications
information sources on evolutionary algorithms

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CONVEX OPTIMIZATION IN TRAINING CMAC NEURAL NETWORKS

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Simplicity of structure and learning algorithm play an important role in the real-time application of neural networks. The Cerebellar Model Articulation Controller (CMAC) neural network, with asso-cia-tive memory type of organization and Hebbian learning rule, satisfies these two conditions. But, Hebbian rule gives poor performance during off-line identification, which is used as a preparation phase for on-line implementation.
In this paper we show that optimal CMAC network parameters can be found via convex optimiza-tion technique. For standard ℓ_2 approximation this is equivalent to the solution of Quadratic Program (QP), while for ℓ_1 or ℓ_∞ approximation solving Linear Program (LP) suffices. In both cases physical constraints on parameter values can be included in an easy and straightforward way.

(Fig. 9, Tab. 2, Ref. 13 – original in English) *Authors*

CMAC neural network
identification
convex optimization
quadratic program
linear program

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NONLINEAR PHENOMENA IN POWER ELECTRONICS

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A new class of phenomena has recently been discovered in nonlinear dynamics. New concepts and terms have entered the vocabulary to replace time functions and frequency spectra in describing their behavior, e.g. chaos, bifurcation, fractal, Lyapunov exponent, period doubling, Poincaré map, strange attractor etc. The main objective of the paper is to summarize the state of the art in the advanced theory of nonlinear dynamical systems and illustrate its application in power electronics by three exam-ples.

(Fig. 28, Tab. 2, Ref. 35 – original in English) *Author*

nonlinear dynamics
theory of chaos
routes to chaos
fractal geometry
power electronics

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AUTOMATIKA 42(3–4),143–150(2001)

EVOLUTIONARY ALGORITHM BASED OFF-LINE PATH PLANNER FOR UAV NAVIGATION

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An off-line path planner for Unmanned Air Vehicles is presented. The planner is based on Evolutionary Algorithms, in order to calculate a curved pathline with desired characteristics in a three--dimensional environment. The pathline is represented using B-Spline curves, with the coordinates of its control points being the genes of the Evolutionary Algorithm artificial chromosome. The method was tested in an artificial three-dimensional terrain, for different starting and ending points, provi-ding very smooth pathlines under difficult constraints.

(Fig. 9, Ref. 6 – original in English) *Authors*

B-Splines
3-D path planning
evolutionary algorithms
navigation
UAV

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IZVEDBA POOPĆENIH PREDIKCIJSKIH REGULATORA U PROSTORU STANJA

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U članku se opisuje izvorna metodologija projektiranja i izvedbe poopćenih predikcijskih regulatora (GPC-a) zasnovana na primjeni CARIMA modela u prostoru stanja za predikciju stanja. Opisani CARIMA model ekvivalentan je najčešće korištenom CARIMA modelu koji se koristi pri ulazno/iz-laznoj formulaciji GPC-a. Uspostavljena je veza između stohastičkog dijela modela i polinoma $\boldsymbol{T}_i(z^{-1})$, čime je omogućena sinteza regulatora kada je poznat bilo koji od njih. Za estimaciju nemjerljivih veličina stanja predložen je estimator punog reda, koji, što je posebno važno, ima polove jednake korijenima polinoma $\boldsymbol{T}_i(z^{-1})$.

(Sl. 4, Lit. 10 – original na engleskom) *Autori*

CARIMA model
optimizacija
prediktivno upravljanje
upravljanje u prostoru stanja

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Prethodno priopćenje

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NISKOPROPUSNI ESTIMATOR BRZINE VRTNJE I UBRZANJA ZASNOVAN NA OBRADI SIGNALA S ENKODERA

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U članku je opisan postupak dobivanja stvarne vrijednosti kutne brzine i ubrzanja iz vremenski i amplitudno diskretnog signala s enkodera. Za sustav regulacije brzine vrtnje, posebno u automatiziranim sustavima i u robotici, potrebno je da mjereni signali kutne brzine i ubrzanja imaju što veću graničnu frekvenciju. Pomirenje tog zahtjeva i zahtjeva za kvalitetnim filtriranjem osnovni je problem u postupku diferenciranja signala s enkodera. Predloženi postupak estimacije je zapravo nelinearna kombinacija postupka diferenciranja s filtriranjem i filtra u prostoru stanja. Prvi postupak osigurava kvalitetno filtriranje estimiranog signala, dok drugi osigurava širok frekvencijski opseg i dobro slijeđenje referentnog ulaznog signala. Predloženi estimator ima promjenljivu graničnu frekvenciju ovisnu o spektru ulaznog enkoderskog signala. Predstavljene su i uspoređene dvije inačice estimatora. Prvi daje samo estimiranu vrijednost brzine a drugi i brzine i ubrzanja. Simulacijski i eksperimentalni rezultati pokazuju dobro ponašanje sustava s predloženim estimatorom. U radu su korišteni 5k c/r enkoder i rezolver kao visokorezolucijski mjerni član.

(Sl. 9, Lit. 15 – original na engleskom) *Autori*

estimacija ubrzanja
estimacija brzine vrtnje
enkoder signali
diferenciranje s filtriranjem

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AUTOMATIKA 42(3–4),177–188(2001)

MODELIRANJE CJEVOVODA KAO SUSTAVA S USREDOTOČENIM PARAMETRIMA

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U članku se opisuje postupak pojednostavljenja matematičkih modela cjevovoda. Lineariziran je nelinearni matematički model s raspodijeljenim parametrima iz čega je dobivena prijenosna funkcija. Cjevovod je prikazan kao dvoulazni sustav. Analizirana su dva međusobno povezana prikaza triju različitih transcedentnih prijenosnih funkcija koje se potom nadomještaju racionalnim prijenosnim funkcijama uporabom Taylorovog razvoja u red. Izvedeni modeli valjani su za niske frekvencije i koriste se kako bi se došlo do boljih aproksimacija. Uspoređuje se visokofrekvencijsko pojačanje transcedentnih i racionalnih prijenosnih funkcija. Zbog aproksimacije visokofrekvencijskog pojačanja izvedeni su modeli valjani samo za dobro prigušene cjevovode. Izvedeni modeli, koji opisuju cjevovod kao sustav s usredotočenim parametrima, provjereni su na realnom cjevovodu.

(Sl. 3, Lit. 5 – original na engleskom) *Autori*

modeliranje
aproksimacija modela
sustav s raspodijeljenim parametrima
sustav s usredotočenim parametrima
cjevovod

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ROBOTI ZA RAZMINIRANJE – ZAHTJEVI I OGRANIČENJA

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Razminiranje je jedno od najvažnijih potencijalnih područja primjene mobilnih robota. Korištenje robota u minskom polju povezano je sa strogim zahtjevima na pokretljivost u okolišu prekrivenom gustom vegetacijom koji sadrži različite prepreke. Povrh toga, robot mora omogućiti pregled cijelog područja detektorom, izbjegavajući prethodno otkrivene mine. U radu su analizirane različite strukture robota za razminiranje s obzirom na upravljanje, navigaciju, veličinu i način kretanja.

(Sl. 15, Lit. 22 – original na engleskom) *Autori*

mobilni robot
razminiranje

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Preliminary communication

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A LOW-NOISE ESTIMATOR OF ANGULAR SPEED AND ACCELERATION FROM SHAFT ENCODER MEASUREMENTS

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This paper deals with the differentiation of discrete-time, quantized signal provided by an encoder. In particular, speed and acceleration estimation with large bandwidth is required for feedback control in automation and robotics applications. The main problem in the differentiation of the encoder measurements is to combine the large bandwidth and the strong filtering of the quantization noise. The proposed speed acceleration estimator relies on typical filtered differentiator nonlinearly combined with a state-variable filter. The former produces a strongly filtered estimation, while the latter is characterized by a large bandwidth, in order to track fast signal transients. In this way, the resulting estimator has a variable bandwidth depending on the harmonic content of the encoder signals. Two versions of the estimator are presented and compared. The first one gives only a speed estimation, while the second provides also an acceleration signal. Simulation and experimental tests verify the performance of the proposed solutions. A 5k c/r encoder and a high resolution sine/cosine encoder are considered.

(Fig. 9, Ref. 15 – original in English) Authors

acceleration estimation
encoder measurements
nonlinear observers
real differentiators
velocity estimation

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DESIGN OF GPC's IN STATE SPACE

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This paper introduces a methodology for the original design of generalised predictive controllers (GPC's) based on the use of a state space CARIMA model to carry out those predictions. The CARIMA model presented is equivalent to the CARIMA model commonly used in the input/output (I/O) formulation of the GPC's. A connection is settled among the stochastic part of this model and the filter polynomials $\boldsymbol{T}_i(z^{-1})$, making possible the design of the controller once any one of them is known. It is also remarkable that for the estimation of non-measurable states, a full rank observer is proposed, and the fact that its poles are equal to the roots of the filter polynomials $\boldsymbol{T}_i(z^{-1})$ can also be appreciated.

(Fig. 4, Ref. 10 – original in English) Authors

CARIMA model
optimization
predictive control
state space design

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DEMINING ROBOTS – REQUIREMENTS AND CONSTRAINTS

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One of the most urgently needed applications for mobile robots is demining. Using robots in a minefield is accomplished with severe demands for mobility in an environment covered with dense vegetation and containing various obstacles. Furthermore, it is required that robot should cover the whole area with the detector, avoiding previously detected mines. Different configurations of demining robots are analyzed regarding control and navigation, size and locomotion.

(Fig. 15, Ref. 22 – original in English) Authors

demining
mobile robot

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MODELLING OF THE PIPELINE AS A LUMPED PARAMETER SYSTEM

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The paper deals with the simplification of pipeline models. A nonlinear distributed parameters model is linearised and its transfer function given. The pipeline is represented as a two-port system. Two causal representations – the hybrid ones which are used in practice – are studied further. They involve three different transcendent transfer functions which are then approximated by rational transfer functions using a Taylor series expansion. The derived models are valid for low frequencies and are used to discuss how to obtain better approximation. They equalise the high frequency gain of the transcendent and rational transfer functions and employ a Padé approximation. Due to the approximation of the high frequency gain, the derived models are only valid for a class of models – namely – well damped pipelines. The derived models which describe the pipeline as a lumped parameter system were verified on a real pipeline using experiment data.

(Fig. 3, Ref. 5 – original in English) Authors

modelling
model approximation
distributed-parameter system
lumped-parameter system
pipelines

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