ROMANOVSKIY, Yu.M.; MASTRYUKOVA, T.A.; BODROV, V.P.; POPOV, Ye.M.; KABACHNIK, M.I.

Use of high-speed computers in the analysis of mixtures of organophosphorus compounds by their infrared spectra. Izv. AN SSSR. Ser.khim. no.3:569-572 Mr '64. (MIRA 17:4)

1. Moskovskiy gosudarstvennyy universitet im. M.V.Lomonosova, Institut elementoorganicheskikh soyedineniy AN SSSR i Institut organicheskoy khimii im. N.D.Zelinskogo AN SSSR.

ROSHCHUPKIN, V.P.; POPOV, Ye.M.

Calculation of electrooptical parameters and analysis of absorption band intensities in the infrared of complex molecules. Nitrile compounds. Opt. i spekt. 15 no.2:202-207 Ag '63. (MIRA 17:1)

POPOV, Ye.M.; SHLYAPOCHNIKOV, V.A.

Analysis of the vibrational spectra of polynitroalkanes.
Opt. i spektr. 15 no.3:325-331 S '63. (MIRA 16:10)

POPOV, Ye.M.; SHLYAPOCHNIKOV, V.A.

Electrooptical parameters of nitromethane. Opt. i spektr. 14 no.6:779-786 Je '63. (MIRA 16:8)

(Methane--Dipole moments)

POPOV, Ye.M.; STOYANOVICH, F.M.; FEDOROV, B.P.; ANDRIANOVA, G.M.

Ultraviolet and infrared spectra of 2-thienyl sulfides. Part 6.
Zhur.ob.khim. 33 no.7:2261-2266 Jl '63. (MIRA 16:8)

1. Institut organicheskoy khimii imeni N.D.Zelinskogo AN SSSR.
(Bithiophene--Spectra) (Sulfides)

L 17789-63 EWP(j)/EPF(c)/EWT(1)/EWT(m)/BDS AFFTC/ASD/ESD-3/IJP(C)
Pc-4/Pr-4 RM/WW/MAY

ACCESSION NR: AP3005842 S/0051/63/015/002/0202/0207

AUTHOR: Roshchupkin, V.P.; Popov, Ye.M.

TITLE: Calculation of the electro-optical parameters and analysis of the absorption band intensities in the infrared spectra of complex molecules. Nitrile compounds

SOURCE: Optika i spektroskopiya, v.15, no.2, 1963, 202-207

TOPIC TAGS: electro-optical parameter , force constant , absorption spectrum, nitrile compound , acetonitrile

ABSTRACT: The purpose of the work was to determine, on the basis of experimental data on absolute band intensities in the infrared spectrum, the electro-optical parameters of the CCl_3CN molecule and to interpret the variation in band intensities observed in the acetonitrile series with replacement of the H atoms by Cl. It was assumed that solution of the electro-optical problem for CH_3CN and CCl_3CN would help elucidate the reasons for the variation in the intensity of the infrared absorption bands associated with the CN stretching vibrations. Choice of these molecules was dictated by the considerations that for them there is observed

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a large difference in the intensities of the ν_1 bands and the fact that these molecules have a high degree of symmetry so that the direction of the dipole moment vector is known. The absolute integral intensities were determined by the method of E.B.Wilson and B.Wells (J.Chem.Phys.,14, 578, 1946); the measurements for trichloroacetonitrile were carried out on a UR-10 spectrometer with KBr, NaCl and LiF prisms in a wide range of pl (p = partial pressure; l = length of the absorption cell) values. The measurement accuracy is estimated as 5%; the accuracy in calculating the electro-optical parameters 10%. Experimental data on the other substituted acetonitriles were taken from the literature (W.Zeil, Zs.phys.Chem.,14,230, 1958). The force constants calculated for the four compounds in the series are tabulated, as are the frequencies and modes of vibration in the CCl_3CN molecule. Analysis of the vibration modes and IR absorption intensities indicates that the main reason for the alteration in the intensity of the ν_1 band in the spectra of CH_3CN and CCl_3CN, and presumably the intermediate substituted compounds, is not change in the equilibrium value of the length of the CN bond or the character of this bond, but change in the character of the electro-optical parameters of the neighboring CC bond, which contributes strongly to the ν_1 vibrations. "The authors are deeply grateful to L.G.Stolyarova for synthesis of the trichloroacetonitrile, and L.A.Gribov and N.S.Andreyev for detailed discussions of the work."

Orig.art.has: 1 formula, 1 figure and 4 tables.

GRIBOV, L.A.; POPOV, Ye.M.

Determining the electrooptical parameters and intensities in infrared absorption spectra of methane and ethane. Opt.i spektr. 13 no.5:663-667 N '62. (MIRA 15:12)
(Methane--Spectra) (Ethanes--Spectra)

POPOV, Ye.M.; MEDENIKOVA, N.Ye.

Isomerization of ethyldichlorothionophosphate. Zhur.ob.khim. 32 no.9:3080-3083 S '62. (MIRA 15:9)
(Phosphorothioic acid) (Isomerization)

POPOV, Ye.M.; TSVETKOV, Ye.N.; CHZHAN ZHUN-YUY [Chang Jung-yü]; MEDVED', T.Ya.

Raman and ultraviolet absorption spectra of some unsaturated organophosphorus compounds. Zhur.ob.khim. 32 no.10:3255-3260 O '62. (MIRA 15:11)
(Phosphorus organic compounds—Spectra)

POPOV, Ye.M.; KAGAN, G.I.

Theoretical analysis of vibration spectra of vinyl alkyl sulfides.
Opt. i spektr. 11 no.6:730-734 D '61. (MIRA 14:11)
(Sulfides--Spectra) (Molecules--Vibration)

POPOV, Ye.M.; ANDREYEV, N.S.; KAGAN, G.I.

Vibrational spectra of vinyl ethers. Rotational isomerism. (MIRA 15:2)
Opt. i spektr. 12 no.1:37-41 Ja '62.
(Ethers—Spectra)
(Isomerism)

POPOV, Ye.M.; KAGAN, G.I.

Vibrational spectra of vinyl alkyl ethers; theoretical analysis. Opt. i spektr. 12 no.2:194-199 F '62. (MIRA 15:2)
(Ethers--Spectra)

S/051/62/012/005/002/021
E032/E514

AUTHORS: Gribov, L.A. and ~~Popov, Yu.M.~~

TITLE: Electro-optical parameters of polyatomic molecules and their calculation from experimental data on the intensity and polarization in the infrared absorption spectra

PERIODICAL: Optika i spektroskopiya, v.12, no.5, 1962, 546-549

TEXT: The solution of the converse electro-optical problem is discussed in a general form. It is pointed out that experiment will in general yield only two quantities, namely, the derivative of the dipole moment of the molecule with respect to the normal coordinate (except for the sign since the intensity of the absorption band depends on the square of the derivative) and the direction of the polarization vector. In addition, the form of the vibrations is known from the solution of the mechanical problem. It is shown that the theory put forward by Vol'kenshteyn et al. (DAN SSSR, 30, 784, 1941; ZhETF, 11, 642, 1941; J.Phys., 9, 101, 1944; ZhETF, 15, 124, 1945) is, in principle, capable of yielding this solution for a large number

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POPOV, Ye.M.; GRIBOV, L.A.

Calculation of the electrooptical parameters of certain polyatomic molecules. Opt. i spektr. 12 no.6:703-710 Je '62.
(MIRA 15:5)
(Molecular spectra)

43405
S/051/62/013/005/007/017
E039/E420

AUTHORS: Gribov, L.A., Popov, Ye.M.

TITLE: Determination of the electro-optical parameters and calculation of intensity in the infrared absorption of methane and ethane

PERIODICAL: Optika i spektroskopiya, v.13, no.5, 1962, 663-667

TEXT: In previous papers the method of determining the electro-optical parameters of multiatomic molecules from experimental data on the intensity and polarisation of infrared absorption bands has been developed and applied to hydrocyanic acid, acetylene and ethylene; this work is now extended to include methane and ethane. Derivatives of the dipole moments are calculated using normal coordinates for methane and its deuteron-exchange compounds CH_4, CD_4, CH_3D, CD_3H and CH_2D_2. The following values of the electro-optical parameters for methane are obtained

$$\left(\frac{\partial\mu}{\partial q} - \frac{\partial\mu}{\partial q'}\right) = 0.65 \frac{D}{A}\ ;\quad \left(\frac{\partial\mu}{\partial\alpha} - \frac{\partial\mu}{\partial\alpha'}\right) = 0.03 \frac{D}{A}\ ;\quad \mu = 0.28\ D$$

Card 1/2

S/079/62/032/010/004/008
D204/D307

AUTHORS: Popov, Ye.M., Tsvetkov, Ye.N., Chang, Jung-Yü, and Medved', T.Ya.

TITLE: Raman and ultraviolet spectra of some unsaturated organic compounds of phosphorus

PERIODICAL: Zhurnal obshchey khimii, v. 32, no. 10, 1962; 3255 - 3260

TEXT: Raman and UV spectra of vinyl compounds of the type $>C=\dot{C}-P<=O$, $>C=\dot{C}-P<=S$ and $>C=\dot{C}-\ddot{P}<$ and of the analogous allyl derivatives were investigated in view of the lack of publications concerned with the spectra of these systems. The Raman spectra were taken on an ИСП-51 (ISP-51) spectrograph, the line intensities being measured photoelectrically with an accuracy of ± 15 %. The UV spectra were investigated on an СП-41 (SP-41) spectrophotometer. The compounds were tested in a solution of heptane. The characteristic vibrations of the C = C bonds in the allyl compounds were very similar to those of C = C in alkenes possessing a termi-

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Raman and ultraviolet spectra of ...

nal = CH_2 group, and the UV spectra of $CH_2 = CH - C_4H_9$ and $CH_2 =$ $= CH - CH_2 - (O)P(OC_4H_9)_2$ were practically the same, indicating that in these compounds there is practically no interaction between the C = C bonds and the P = O, P = S or the trivalent P atom separated from the double bond by a methylene group. In the vinyl derivatives, the C = C Raman line intensities were generally lowered and the UV absorption bands were slightly shifted towards the shorter wavelengths, in comparison with hexene-1. No indication of conjugation in these systems was thus obtained. The assistance of M.I. Kabachnik P.P. Shorygin and V.A. Petukhov is acknowledged. There are 3 tables.

SUBMITTED: July 10, 1961

Card 2/2

S/020/62/145/004/009/024
B178/B102

24.6111

AUTHORS: Gribov, L. A., and Popov, Ye. M.

TITLE: Valence optical scheme and theoretical considerations of intensity and polarization in absorption spectra of the fundamental vibrations of polyatomic molecules

PERIODICAL: Akademiya nauk SSSR. Doklady, v. 145, no. 4, 1962, 761-763

TEXT: An attempt is made to find a set of electrooptical quantities with which the intensity and polarization of molecule spectra can be analyzed. Proceeding from

$$\left(\frac{\partial\vec{\mu}}{\partial Q_i}\right)_0 = \left[\{e\}\left|\frac{\partial\mu}{\partial q}\right| + \{\mu\}\left|\frac{\partial e}{\partial q}\right|\right]\|q\|; \quad \left|\frac{\partial e}{\partial q}\right| = S^{-1}(\Delta E\tilde{B}T - E). \qquad (1)$$

the amount of $(\partial\vec{\mu}/\partial Q_i)_0$ and its direction can be determined experimentally. The elements of $|\partial\mu/\partial q|$ and $\{\mu\}$ are the totality of the electrooptical parameters sought. The number of the possible equations for nonsymmetrical

Card 1/2

YAGUDAYEV, M.R.; POPOV, Ye.M.; YAKOVLEV, I.P.; SHEYNKER, Yu.N.

Frequencies and intensities of infrared absorption bands of the stretching and deformation vibrations of the NH_2 group in primary amines. Izv. AN SSSR Ser. khim. no.7:1189-1196 Jl '64. (MIRA 17:8)

1. Institut khimii prirodnykh soyedineniy AN SSSR i Institut organicheskoy khimii imeni Zelinskogo AN SSSR.

L 16665-65 EWT(m)/EPF(c)/EWP(j)/T Pc-4/Pr-4 ESD(t)/SSD/AFWL/AFMD(t) RM

ACCESSION NR: AP4044700 S/0062/64/000/008/1393/1401

AUTHOR: Kogan, G. A.; Popov, Ye. M.

TITLE: Vibration spectra and structural characteristics of polyene compounds

SOURCE: AN SSSR. Izvestiya. Seriya khimicheskaya, no. 8, 1964, 1393-1401

TOPIC TAGS: polyene compound, vibration spectrum, structure, butadiene, force field, polyene chain length, polyene dicarboxylic acid ester, force field redistribution, IR spectrum, dipole moment

ABSTRACT: The vibration spectra of 1,3-butadiene and trans-1,3,5-hexatriene were calculated to obtain information about the force field of conjugated molecules and the relationship between the force field and the length of the polyene chain was studied. Every association of the butadiene force constants agrees with the concept of π-electron delocalization for a system of this type. The force constants of the butadiene and hexatriene double bonds were much less than in compounds with an isoprene type double bond and of ordinary carbon bonds in saturated

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hydrocarbons. Interaction of the two double bonds and of the double bond and ordinary bonds was also indicated. Since hybridization of the carbon atom did not change the force constant of the C-C bond, it was concluded the force field of the butadiene was associated with π-electron delocalization. Examination of the vibration of models of polyene dicarboxylic acid esters [$O{=}C{-}(C{=}C)_n{-}C{=}O$, n=2-8] showed that increasing the length of the polyene chain did not cause significant redistribution or equalization of the force field of the molecule in its normal electron state. A study of the polar properties of polyene compounds involving measurement of the absolute integral intensity of the absorption bands in the 1600 cm^{-1} region in IR spectra of α,ω-substituted polyenes of the type X-(CH=CH)$_n$-$COOC_2H_5$, where X=-$COOC_2H_5$(n=2-8), -CH_3, -NO_2 and -CHO (n=2-4) showed the intramolecular effect of the substitutents tapered out rapidly with increasing length of the conjugated chain. From analysis of the intensity of the butadiene IR spectra it was concluded that the double bond has a dipole moment of about 1.3D with the central carbon atom (C_2 or C_3) being the positive end of the dipole. Molecules of linear polyenes are systems of conjugated and polar carbon bonds, with the arrangement of the bonds as well as the charge on the atoms

L 16665-65
ACCESSION NR: AP4044700

along the polyene chain alternating. Orig. art. has: 5 tables and 2 figures

ASSOCIATION: Institut organicheskoy khimii im. N. D. Zelinskogo Akademii nauk SSSR (Institute of Organic Chemistry, Academy of Sciences SSSR)

SUBMITTED: 17Apr64 ENCL: 00

SUB CODE: OC NO REF SOV: 013 OTHER: 011

Card 3/3

ACC NR: AT6016821 (A) SOURCE CODE: UR/0000/65/000/000/0162/0167

AUTHOR: Glebov, I. A.; Popov, Ye. N.

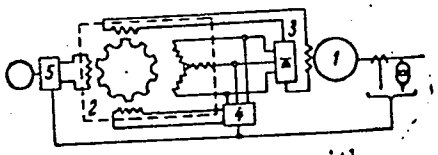
ORG: none

TITLE: Investigation of 6- and 12-phase operation of a rectifier and inductor-type generator 25

SOURCE: AN SSSR. Institut elektromekhaniki. Teoriya, raschet i issledovaniye vysokoispol'zovannykh elektricheskikh mashin (Theory, design, and research of electrical machinery in constant use). Moscow, Izd-vo Nauka, 1965, 162-167

TOPIC TAGS: electric generator, semiconductor rectifier, electric generator unit

ABSTRACT: The excitation system of "Elektrosila" 200-, 300-Mw (built) and 500-Mw (blueprint) turbogenerators consists (see figure) of these parts: 1 - main synchronous generator; 2 - inductor-type h-f generator (exciter); 3 - semiconductor rectifier; 4 - reactors; 5 - magnetic amplifier. The inductor-type generator having a relatively high reactance causes an undesirable current ripple in the turbogenerator field winding. As a remedy, a 12-phase rectification circuit with



Excitation system with inductor-type h-f generator

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ACC NR: AT6016821

two 30°-shifted 3-phase windings was suggested by R. A. Lyuter. The suggestion was experimentally verified on a 29-kw machine simulating 6- and 12-phase conditions. Oscillographically measured the ripple ratios were 52% for the 6-phase circuit and 27% for the 12-phase. However, the 12-phase system had a less favorable external characteristic ($U_d = f(I_d)$). Hence, further experiments are held desirable. Orig. art. has: 5 figures and 1 formula.

SUB CODE: 09 / SUBM DATE: 04Aug65 / ORIG REF: 003 / OTH REF: 001

Card 2/2

POPOV, Ye.N., kand. med. nauk

Acute cholecystitis in elderly persons. Trudy Inst. im. N.V. Sklif. 9:60-70 '63. (MIRA 18:6)

1. Moskovskiy gorodskoy nauchno-issledovatel'skiy institut skoroy pomoshchi imeni Sklifosovskogo.

SOLOMINA, Ye.N.; POPOV, Ye.N.

Disorders of the large arteries of the extremities in protracted septic endocarditis. Sov.med. 24 no.1:57-63 Ja '60. (MIRA 13:5)

1. Oz obshchey i gospital'noy terapevticheskoy (zav. - deystvitel'nyy chlen AMN SSSR prof. Ye.M. Tareyev) i khirurgicheskoy (zav. - prof. A.N. Velikoretskiy) kliniki sanitarno-gigiyenicheskogo fakul'teta I Moskovskogo ordena Lenina meditsinskogo instituta imeni L.M. Sechenova na baze 24-y gorodskoy bol'nitsy (glavnyy vrach V.P. Uspenskiy).

(ENDOCARDITIS complications)
(LEG blood supply)

POPOV, Ye. N.

Popov, Ye. N.

"Acute mediastinitis in injuries of the intestine inflicted by foreign bodies and instruments." First Moscow Order of Lenin Medical Inst imeni I. M. Schenov. Moscow, 1956. (Dissertation for the Degree of Doctor in Medical Science.)

Knizhaya letopis
No. 19, 1956. Moscow

POPOV, Ye.M. (Moskva, 8-ya ul. Oktyabr'skogo polya,d.5.kv.5)

Perforation of the aorta in esophageal trauma caused by foreign bodies. Grud. khir. 1 no.3:91-97 My-Je '59. (MIRA 15:3)

1. Iz Moskovskogo nauchno-issledovatel'skogo instituta skoroy pomoshchi imeni N.V. Sklifosovskogo (dir. - zasluzhennyy vrach USSR M.M. Tarasov, glavnyy khirurg -- prof. B.A. Petrov) i kafedry obshchey i gospital'noy khirurgii (zav. - prof. A.N. Velikoretskiy) I Moskovskogo ordena Lenina meditsinskogo instituta imeni I.M. Sechenova (dir. - prof. V.V. Kovanov).
(AORTA--WOUNDS AND INJURIES)
(ESOPHAGUS--FOREIGN BODIES)

SOLODOV, Aleksandr Vasil'yevich; POPOV, Ye.P., retsenzent; PETROV, F.S., dots., red.; KRYUCHKOVA, V.N., tekhn. red.

[Linear automatic control systems with variable parameters] Lineinye sistemy avtomaticheskogo upravleniia s peremennymi parametrami. Moskva, Fizmatgiz, 1962. 324 p. (MIRA 15:6)

1. Chlen-korrespondent Akademii nauk SSSR (for Popov).
(Automatic control)

POPOV, Ye.P. (Leningrad)

Study of self-oscillatory systems with logic devices. Izv. AN SSSR. Otd. tekh. nauk. Energ. i avtom. no.4:116-121 Jl-Ag '62. (MIRA 15:8)

(Automatic control)

POPOV, Ye. P. Lt. Col.

"Calculating the Compression of Non-Cylindrical Spiral Springs," Prik. mat. i mekh. 4, No.1, 1940

RUPOV, Ye. P.

"Theory and Design of Ductile Elastic Compounds," Leningrad, 1947

POPOV, E. P.

PA 16T70

USSR/Springs, Spiral
Mathematics, Applied

Feb 1947

"Calculation of Springs," E. P. Popov, 22 pp

"Inzhenernyy Sbornik" Vol III, No 2

Treatment of non-linear characteristics (relationship between load and displacement) in a spiral spring of arbitrary form subjected to an axial load, when a number of the coils are brought into contact.

16T70

Popov, E. P.

*Popov, E. P. **Nelineĭnye zadachi statiki tonkikh sterzhneĭ.** [Nonlinear Problems of the Statics of Thin Rods]. Gosudarstv. Izdat. Tekh.-Teor. Lit. Moscow-Leningrad, 1948. 170 pp. (1 plate).

This is a self-contained monograph devoted to a systematic exposition of solutions of a broad class of elastostatic problems on large deflections of thin rods and flat blades. The theory, including a careful derivation of the Kirchhoff equilibrium equations, is contained in the first chapter (49 pp.). The remaining two chapters (103 pp.) deal with the applications of the theory to diverse problems on deflection and stability of thin rods deformed in one plane. The book summarizes all significant published results on problems of this category up to 1948. A distinguishing feature of the work is that the exact solutions are presented in a form suitable for numerical computation, so that they can be used directly by a stress analyst. The bibliography contains 85 items, the earliest of which is dated 1867.

I. S. Sokolnikoff (Los Angeles, Calif.).

Source: Mathematical Reviews, Vol 13 No. 1

ROSTOVTSEV, G.G.; PANOVKO, Ya.G. POPOV, Ye.P., redaktor; KAN, S.N., retsenzent; PAVLOVA, T.P., tekhnicheskiy redaktor.

[Structural mechanics of the airplane] Stroitel'naia mekhanika samoleta. Vol. 1. [General course] Obshchii kurs. Leningrad, Leningradskaia Krasnoznamennaia voenno-vozdushnaia inzhenernaia akademiia. 1950. 437 p. [Microfilm] (MLRA 8:1)
(Airplanes--Design and construction)

POPOV, Ye.P., (Leningrad)

Accounting for the nonlinearity influence in designing servosystems.
Avtom. i telem. 14 no.6:690-711 N-D '53. (MLRA 10:3)
(Servomechanisms)

POPOV, Ye.P.; SOBOLEV, O.K., redaktor; AKHLAMOV, S.N., tekhnicheskiy redaktor.

[Dynamics of automatic control systems] Dinamika sistem avtomaticheskogo regulirovaniia. Moskva, Gos. izd-vo tekhniko-teoret. lit-ry, 1954. 798 p. (MLRA 8:2)
(Automatic control)

USSR/Engineering - Automatic Control FD-1107

Card 1/1 Pub. 41-1/13

Author : Popov. Ye. P., Leningrad

Title : Approximate study of self-excited oscillations and forced oscillations of nonlinear systems of high order on the basis of the harmonic linearization of nonlinearities

Periodical : Izv. AN SSSR. Otd. tekh. nauk 5, 3-38, May 1954

Abstract : Extends one of the variants of the method of harmonic balance of Krylov and Bogolyubov to a new group of problems, developing a more direct method for obtaining the approximate dependence of the frequency and amplitude of self-excited oxcillations and forced oscillations (with a given forced frequency) on the parameters of the system, as well as for finding the ranges of their existence. The presented method consists of a combination of the method of harmonic balance of M. M. Krylov and N. N. Bogolyubov and the method of determining stability limits of linear systems resulting from the analytical expression of Mikhaylov's criterion. Twenty-two references. Diagrams

Institution :

Submitted : January 23, 1954

POPOV, E.P.

Reply to M.A.Aizerman's and I.M.Smirnova's note on E.P.Popov's article.
Izv. AN SSSR Otd.tekh. nauk no.10:189-191 O '54. (MIRA 8:3)
(Vibrations)(Aizerman, M.A.)(Smirnova, I.M.)

POPOV, Ye.P.

Reply to N.M.Aleksandrovskii's and G.K.Krug's remarks concerning my article "Nonlinearity effects in the design of servomechanisms." (Avtom. i telem. 14 no.6 '53.) Avtom. i telem. 15 no.4:362-363 Jl-Ag '54. (MLRA 7:11)
(Servomechanisms)

USSR

On the Approximate Treatment of Auto-

[illegible]

U.S.S.R.

This is a further development of Frylov's [illegible] method of harmonic balance on the basis of [illegible] the existence of [illegible] solution is then utilised. Three classes of non-linear systems are considered and the ways of solving the basic problems of [illegible] regulating systems. (Bibl. 12)

Evaluation B-83749

POPOV, E.P.

USSR/Physics - Mechanics

Card 1/1 Pub. 22 - 6/48

Authors : Popov, E. P.

Title : Thorough determination of the first approximation during the study of auto-oscillations of nonlinear high-order systems

Periodical : Dok. AN SSSR 98/3, 345-348, Sep 21, 1954

Abstract : A perfect solution for the cases where higher harmonics of the argument must be taken into consideration for the calculation of the first harmonics of a nonlinear function (harmonic linearization), is described. It was established that the first harmonics of the function (f) is determined not only by the first harmonics (x) but also by certain combination members composed of all (X) harmonics. The role of these combination members, in solving the problem of auto-oscillation of nonlinear high-order systems, is explained. Formulas for the coefficients of harmonic linearization, are included. Five USSR references (1934-1954). Graphs; drawing.

Institution : ...

Presented by: Academician N. N. Bogolyubov, June 9, 1954

Evaluation B-83749, 4 Apr 55

Popov, E. P.

USSR/ Engineering - Follow-up systems

Card 1/1 : Pub. 22 - 9/49

Authors : Popov, E. P.

Title : Unmodulated frequencies of a non-linear system of a high order during slowly varying external-affecting force

Periodical : Dok. AN SSSR 98/4, 545-547, Oct. 1, 1954

Abstract : Using a sample-equation, an approximative method is described in connection with the determination of an effect of a slowly-varying feeding force on the frequency carriers of automatic control and measuring devices of following-up systems. Five references (1937-1954).

Institution : ...

Presented by : Academician N. N. Bogolyubov, June 8, 1954

Evaluation B-83749

SOV/124-57-5-5180

Translation from: Referativnyy zhurnal. Mekhanika, 1957, Nr 5, p 12 (USSR)

AUTHOR: Popov, Ye. P.

TITLE: The Approximate Determination of Self-sustained and Forced Oscillations in Automatic Control Systems (Priblizhennoye opredeleniye avtokolebaniy i vynuzhdennykh kolebaniy v sistemakh avtomaticheskogo regulirovaniya)

PERIODICAL: Tr. 2-go Vses. soveshch. po teorii avtomat. regulirovaniya. Vol. 1. Moscow-Leningrad, Izd-vo AN SSSR, 1955, pp 219-248

ABSTRACT: The paper describes the application of N. M. Krylov's and N. N. Bogolyubov's harmonic-equilibrium method to the investigation of the periodic modes of oscillation of some nonlinear systems. In accordance with the nature of their nonlinear connections, the systems under investigation are divided into three classes. The author describes the harmonic linearization of systems of the various classes, as well as that of systems having a lag. The determination of the periodic mode of oscillation (as well as the clarification of its relationship to the system parameters) is reduced to the solution of equations obtained by equating to zero the coordinates of a certain nominal

Card 1/2

The Approximate Determination of Self-sustained and Forced Oscillations (cont.)

frequency curve constructed for a linearized system. Graphs are adduced for the relationships corresponding to some characteristic cases. The author describes some approximate stability evaluations which are based either on the averaging of the variable coefficients of the perturbed-motion equations or on an analysis of the nature of the nominal frequency curve at points corresponding to possible modes of oscillation. The general premises are illustrated by a number of specific configurations. Neither the question of a substantiation of the methods described in the paper under review nor the evaluation of their accuracy are examined. Undoubtedly, many of these methods will produce satisfactory results only on condition of definite limitations in the properties of the systems investigated. It is noted that in the majority of cases the experiments produce good qualitative and quantitative agreement with the calculations made in accordance with the methods described.

N. N. Krasovskiy

USSR/Mathematics - Automatic Regulation FD-2237

Card 1/1 Pub. 41-5/17

Author : Popov, Ye. P., Leningrad

Title : On the small parameter in the method of harmonic linearization

Periodical : Izv. AN SSSR, Otd, Tekh. Nauk 2, 41-59, Feb 1955

Abstract : Makes an attempt to show the possibility of deriving formulae for harmonic linearization by the small parameter method; demonstrates the complete concurrence of results obtained by the small parameter method and the harmonic linearization method not only for single-value and loop characteristics F (x), but for more general types of nonlinearities F (x, px). Shows the simultaneous existence of autoresonance and filters in problems on the theory of regulation. Formulae, diagrams. Thirteen USSR references.

Institution:

Submitted : November 17, 1954

POPOV, Ye. P. (Prof.)

"Application of the Method of Harmonic Linerisation to the Research on Transitional Processes in Non-linear Systems,"

paper read at the Session of the Acad. Sci. USSR, on Scientific Problems of Automatic Production, 15-20 October 1956.
Avtomatika i telemekhanika, No. 2, p. 182-192, 1957.

9015229

POPOV, Yevgeniy Pavlovich; SOBOLEV, O.K., redaktor; MURASHOVA, N.Ya., tekhnicheskiy redaktor

[Automatic control; fundamental concepts] Avtomaticheskoe reguliro-vanie; osnovnye poniatiia. Moskva, Gos. izd-vo tekhniko-teoret. lit-ry, 1956. 296 p. (MLRA 10:2)
(Automatic control)

POPOV, E P

On the Use of the Harmonic Linearization Method in the Automatic Control Theory. E P Popov (*Doklady Akad Nauk, SSSR*, No 2, 1956; *U S, NACA TM 1406*, Jan. 1957 6 pp. Translation Method in which a given nonlinear equation is replaced by a linear one In establishing the method a small parameter is considered which makes it possible to approximate a solution of the new equation to the given nonlinear equation

POPOV, Ye. P.

"Damping Diagrams of Nonlinear Processes in Automatic Systems,"
by Ye. P. Popov, Leningrad, Avtomatika, No 4, 1956, pp 6-18

The article presents an approximate method of evaluating the quality of transient processes in nonlinear systems simultaneously with the determination of autooscillations and the separation of areas of stability. This method is based on one of the varieties of the harmonic balance method and is called the harmonic linearization method.

Whereas previously a solution to a nonlinear problem was sought for, which solution was close to a nondamping sinusoidal solution (i.e., close to a solution to a linear system located at the stability boundary), the author proposes a new method in which the solution to a nonlinear problem, close to a linear rapidly damping solution far from the stability boundary, is found.

This approximate method of investigating the quality of nonlinear transitory processes yields entirely satisfactory results.

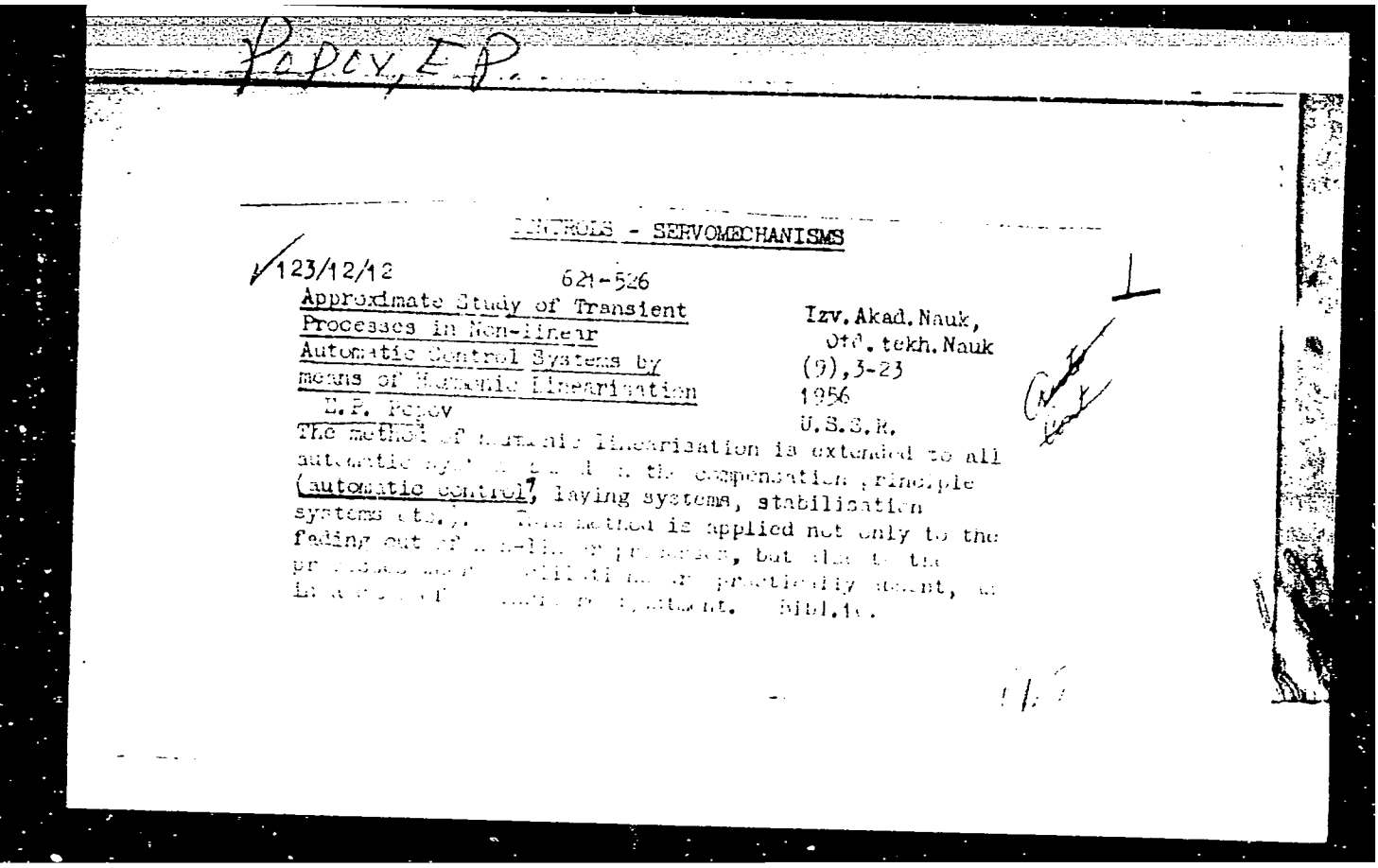
Sum 1274

POPOV, YE. P.

"Approximate methods of studying of nonlinear oscillations in automatic control systems."

Paper presented at the Intl. Symposium on Nonlinear Vibrations, Kiev, USSR, 9-19 Sep 61

Institute of Electrical Engineering of the USSR Academy of Sciences, Leningrad



Popov, E.P.

CONTROLS - SERVOMECHANISMS

123/12/12 621-526

Approximate Study of Transient Processes in Non-linear Automatic Control Systems by means of Harmonic Linearization

E.P. Popov

Izv. Akad. Nauk, Otd. tekh. Nauk (9), 3-23 1956 U.S.S.R.

The method of harmonic linearisation is extended to all automatic [illegible] the compensation principle (automatic control), laying systems, stabilisation systems etc.. This method is applied not only to the fading out of [illegible], but also to the [illegible] practically absent, [illegible] Bibl.16.

POPOV, E.P.

[illegible] SERVOSYSTEMS [illegible]

112/13/2

Estimation of [illegible] Quality and Selection of the [illegible] of High Order Non-Linear Automatic Systems

E.P. Popov, E.I. Khilyuk [illegible]

[illegible] (12), [illegible] 1956

[illegible] the method by [illegible], and (ii) to assess [illegible] by considering certain relay systems. In estimating accuracy of the method it was assumed that the precise solution is obtained by [illegible] the transitory process for the same non-linear [illegible] under the same initial conditions as in [illegible] Bashkirov's method. As an example, [illegible] system is [illegible].

Popov, Ye. P.

USSR/ Mechanics

Card 1/1 Pub. 22 - 10/54

Authors : Popov, Ye. P.

Title : On the application of the harmonic linearization method to the theory of automatic control

Periodical : Dok. AN SSSR 106/2, 211-214, Jan 11, 1956

Abstract : Proof is presented that the introduction of a small parameter into the harmonic linearization method makes the latter more effective and practical in its application to the automatic control theory. Seven USSR references (1934-1955).

Institution : .....

Presented by: Academician N. N. Bogolyubov, July 9, 1955

POPOV E.P.

SUBJECT USSR / PHYSICS CARD 1 / 2 PA - 1746
AUTHOR POPOV,E.P.
TITLE A Generalization of the Asymptotic Method developed by N.N.BOGOLJUBOV in the Theory of Nonlinear Oscillations.
PERIODICAL Dokl.Akad.Nauk, 111, fasc.2, 308-311 (1956)
Issued: 1 / 1957

In the case of many technical problems, particularly in the theory of automatic regulation it is necessary to investigate quickly declining dying down oscillation processes. For this purpose the asymptotic solution of a differential equation of the type: $d^2x/dt^2 + 2b\,dx/dt + c^2x = \varepsilon f(x,dx/dt)$ is necessary. Here ε denotes a small parameter, b and c - real constants, $f(x,dx/dt)$ - an assumed real function. In the case of $\varepsilon = 0$ the solution of the above equation in the case of complex roots of the characteristic equation $p^2 + 2bp + c^2 = 0$ takes the form $x = a\cos\Psi$, $a = a_o e^{-bt}$, $\Psi = \omega t + \Psi_o$, $\omega = \sqrt{c^2-b^2}$. In accordance with the idea of the asymptotic method developed by N.N.BOGOLJUBOV the solution of the given differential equation is sought near $\varepsilon = 0$ in the form $x = a\cos\Psi + \varepsilon\varphi_1(a,\Psi) + \varepsilon^2\varphi_2(a,\Psi) + \ldots$, but with the following expressions for a(t) and $\Psi(t)$: $da/dt = -ba + \varepsilon\Phi_1(a) + \varepsilon^2\Phi_2(a) + \ldots$, $d\Psi/dt = \omega + \varepsilon B_1(a) + \varepsilon^2 B_2(a) + \ldots$, where ω has the same value as above. These expressions for x, da/dt and $d\Psi/dt$ are considered to be formal series, and

INSTITUTION: Leningrad Airforce Academy "A.F.MOZAJSKIJ"

~~POPOV, Ye.P.~~

AUTHOR: FOMINA, Ye.N.

103-10-9/10

TITLE: Seminar on the Automatic Control Theory in Leningrad (1955-1956) (Obshcheleningradskiy seminar po teorii avtomaticheskogo regulirovaniya (1955-1956 gg.))

PERIODICAL: Avtomatika i Telemekhanika, 1957, Vol. 18, Nr 1o, pp. 947-949 (USSR)

ABSTRACT: On January 21, 1955, P.A.Lebedev delivered a lecture on "Stability of a non-Stabilized Movement in the Final Time Interval".
On February 2, 1955, T.N.Sokolov discussed the "Question of the Characteristics of Quality in the Theory of Automatic Control". D.A.Bashkirov discussed the "Finding out of Roots of Algebraic Equations According to the Method of the Successive Divisions".
On June 6, 1955 I.A.Orurk discussed the "Application of Integral Equations on the Occasion of the Investigation of the Transition Processes in Complicated Linear and Nonlinear Systems". N.G.Barinov discussed the "Problem of the Construction of Transition Characteristics in Automatic Control Systems."
On September 27, 1956 Ye.P.Popov discussed the "Approximate Investigation of Transition Processes in some Nonlinear Automatic Systems According to the Method of the Harmonic Linearization."

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Popov, Ye.P.

PHASE I BOOK EXPLOITATION 376

Avtomaticheskoye upravleniye i vychislitel'naya tekhnika, vyp. 1. (Automatic Control and Computing Technique, v. 1) Moscow, Mashgiz, 1958. 302 p. 7,000 copies printed.

Ed.: Solodovnikov, V.V., Doctor of Technical Sciences, Professor; Scientific Ed. of Publishing House: Polyakov, G.F.; Tech. Ed.: Sokolova, T.F.; Managing Ed. for Literature on Machine Building and Instrument Making (Mashgiz): Pokrovskiy, N.V., Engineer.

PURPOSE: The book is intended for engineers and scientific personnel.

COVERAGE: The book is a collection of eleven articles presented at a seminar on the theory and technique of automatic control and computing machines. The seminar was organized by the Scientific and Technical Society of Instrument Making, the Moscow Higher

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Technical School imeni Bauman, and the Moscow Aviation Institute imeni S.Ordzhonikidze. The Moscow Physics and Engineering Institute also participated in the seminar. The first five articles outline the theory of automatic control, the next four describe automatic control systems and system components, and the last two articles discuss differential analyzers. No personalities are mentioned.

TABLE OF CONTENTS:

16.9500

S/112/59/000/012/056/097
A052/A001

Translation from: Referativnyy zhurnal, Elektrotekhnika, 1959, No. 12, p. 158, # 24999

AUTHOR: Popov, Ye.P.

TITLE: On Selection of Parameters of Natural-Oscillation Automatic Control Systems

PERIODICAL: V sb.: Avtomat. upravleniye i vychisl. tekhn. No. 1, Moscow, Mashgiz, 1958, pp. 59-79

TEXT: An approximate analytical method of investigation of natural-oscillation automatic control systems is described. The method is connected with the use of Mikhaylov's linear criterion and is called the harmonic linearization method. The latter is considered in application to automatic systems containing any number of nonlinearities at a slowly varying input action. Suggestions on the analysis of the obtained periodic stability solutions are made. Examples of calculation of natural-oscillation conditions in the systems are given.

A.S.B.

Translator's note: This is the full translation of the original Russian abstract.

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PHASE I BOOK EXPLOITATION SOV/4526

Soveshchaniye po teorii invariantnosti i yeye primeneniyu v avtomaticheskikh ustroystvakh. Kiyev, 1958

Teoriya invariantnosti i yeye primeneniye v avtomaticheskikh ustroystvakh; trudy soveshchaniya (Theory of Invariance and Its Applications to Automatic Devices; Transactions of the Conference Oct. 16-20, 1958) Moscow, 1959. 381 p. No. of copies printed not given.

Sponsoring Agency: Akademiya nauk Ukrainskoy SSR. Otdeleniye tekhnicheskikh nauk.

Resp. Ed.: V.S. Kulebakin, Academician; Editorial Commission: V.A. Bodner, Doctor of Technical Sciences, A.G. Ivakhnenko, Doctor of Technical Sciences, A.Yu. Ishlinskiy, Academician, Academy of Sciences UkrSSR, N.A. Kachanova, Candidate of Technical Sciences, P.I. Kuznetsov, Doctor of Physics and Mathematics, A.I. Kukhtenko, Doctor of Technical Sciences, B.N. Petrov, Corresponding Member, Academy of Sciences USSR, Ye.P. Popov, Doctor of Technical Sciences, G.M. Ulanov, Doctor of Technical Sciences, K.K. Khrenov, Academician, Academy of Sciences UkrSSR, P.I. Chinayev, Candidate of Technical Sciences, and N.M. Chumakov, Candidate of Technical Sciences; Tech. Ed.: G.V. Kruglov.

PURPOSE: This collection of papers is intended for engineers and other specialists working in various fields of automation.

COVERAGE: The collection includes reports and papers presented at the Conference on the Theory of Invariance and Its Applications to Automatic Devices, which was called by the Otdeleniye tekhnicheskikh nauk (Department of Technical Sciences) and the Institut elektrotekhniki (Institute of Electrical Engineering) of the Academy of Sciences of the Ukraine and convened in Kiyev October 16 - 20, 1958. The papers presented are concerned with high-quality automatic control systems designed on the basis of compensating for the effects of disturbances or maintaining the invariance of the quality to be regulated with respect to the disturbances acting on the system. The reports treat the physical and mathematical foundations of invariance in automatic control systems; they also consider methods for designing and calculating invariant systems and problems connected with specific cases of practical applications of compensation in various automatic systems. On the basis of these reports it was established by the Conference that, by utilization of the conditions of compensation and the principle of invariance, it is possible to produce automatic systems and various arrangements which are more perfect from the viewpoint of quality of the regulation and control process, stability, simplicity of construction, and reliability of operation. The following members of the Kiyev Seminar on Automatic Control are mentioned as organizers of the conference: A.I. Kukhtenko, A.G. Ivakhnenko, Yu.G. Kornilov, O.M. Kryzhanovskiy, N.M. Chumakov, N.A. Kachanova, and P.I. Chinayev. References accompany each article.

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8

SOV/24-59-1-8/35

AUTHOR: Popov, Ye.P.

TITLE: ~~Harmonic~~ Linearization Applied to Locate the Stability Regions of Nonlinear Automatic Systems (O vydelenii oblastey ustoychivosti nelineynykh avtomaticheskikh sistem na osnove garmonicheskoy linearizatsii)

PERIODICAL: Izvestiya Akademii Nauk SSSR, Otdeleniye Tekhnicheskikh Nauk, Energetika i Avtomatika, 1959, Nr 1, pp 53-64 (USSR)

ABSTRACT: The systems are those that have one nonlinearity only and which are described by ordinary differential equations with constant coefficients. It is assumed that a periodic solution to the equations exists at the boundary between the regions of stability and instability and that the solutions within the unstable region are also periodic. The oscillations are assumed to be of nearly sinusoidal wave shape with respect to the variable appearing in the nonlinear function (but not necessarily with respect to the other variables). This assumption is essential to the harmonic linearization approximation. The necessary and sufficient conditions for the system to be stable are sought; the sufficient conditions are

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Harmonic Linearization Applied to Locate the Stability Regions of Nonlinear Automatic Systems

found to be exactly those that Lyapunov's direct rigorous method gives. It is pointed out that the method lacks mathematical rigour but that, since it is a very effective one for practical purposes, it should be given a sounder mathematical basis. The method is extensively illustrated by examples; Nyquist diagrams are used to derive the sufficient conditions. There are 9 figures and 9 references of which 7 are Soviet and 2 German.

SUBMITTED: 22nd May 1958

POPOV, Ye.P.

Theory of vibrational smoothing of nonlinear characteristics of automatic control systems with the aid of self-oscillations. Avtom. upr. i vych. tekh. no.2:104-138 '59. (MIRA 13:2)
(Automatic control)

SOV/24-59-4-12/33

16.9500

AUTHOR: Popov, Ye.P. (Leningrad)

TITLE: The Effects of Noise Caused by Vibration on the Stability and Response of a Non-linear Automatic System

PERIODICAL: Izvestiya Akademii nauk SSSR, Otdeleniye tekhnicheskikh nauk, Energetika i avtomatika, 1959, Nr 4, pp 97 - 105 (USSR)

ABSTRACT: A general approximate treatment is given. The system (Figure 1) has one non-linear unit, which is included in the internal feedback loop. Units 1, 2 and 3 are linear as are the feedback and the object. The non-linear differential equation describing the system is (1.1), where $F(x)$ is the non-linear function and the other functions are operator polynomials with constant coefficients. The external vibration noise $f_2(t)$ is defined by Eq (1.2); $f_1(t)$ is the input, which varies much more slowly than $f_2(t)$, in accordance with the condition given. It is assumed that the linear transfer function $R(p)/Q(p)$ contains no harmonics generated by the non-linearity; an approximate solution for x is sought in the form Eq (1.3), in which

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The Effects of Noise Caused by Vibration on the Stability and Response of a Non-linear Automatic System

$x^{o}(t)$ varies slowly and **A** and ϕ are the amplitude and the phase of the forced oscillations at the input to the non-linear unit; these can vary slowly as $x^{o}(t)$ varies. The subsequent steps are a standard harmonic linearization treatment; Figure 2 illustrates typical results obtained from a saturation-type non-linearity.

The second section of the paper deals with the derivation of the linear equation for the response to the input (other than noise). The linearization of Eq (2.2) is used; odd symmetrical functions (i.e. typical non-linearities) are considered; then Eq (2.3) applies, which simplifies the calculations. The response to the useful signal is then described by Eq (2.6), where the gain k depends on the amplitude B and frequency Ω of the noise input. Eq (2.7) gives the stability limit indicated by the characteristic equation; Eq (2.8) is the transfer function of the open-loop system and Eq (2.9) is the same for the closed-loop system.

Card2/3 The third section deals with special cases frequently

AUTHOR: Popov, Ye.P. (Leningrad)

TITLE: On the Determination of the Higher Harmonics in Non-Symmetrical Self-Excited Oscillations.

PERIODICAL: Izvestiya Akademii nauk SSSR, Otdeleniye tekhnicheskikh nauk, Mekhanika i mashinostroyeniye, 1959, No 6, pp 24-30 (USSR)

ABSTRACT: In the analysis of self-excited oscillations of non-linear systems, Krylov N.M. and Bogolyubov N.N. originated in their book on non-linear mechanics a method, called "Harmonic Balance", in which the desired solution was expanded into Fourier series, retaining only the lowest harmonics. In essence, this method constitutes a harmonic linearization along the periodic solution, employing different coefficients for different solutions. Higher approximations were found with the help of special asymptotic series. This method has been used by various authors for special problems, including Magnus, K (VDI Forschungsheft No 451, 1955). Later, a solution employing Fourier series was devised for on-off systems by Tsypkin, Ya.Z. ('Theory of On-Off Systems', Gostekhizdat, 1956) and for systems with a non-linear

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S/179/59/000/06/007/029
E191/E181

On the Determination of the Higher Harmonics in Non-Symmetrical Self-Excited Oscillations

characteristic composed of straight line sections by Ayzerman, M.A., and Gantmakher, F.R. (Prikladnaya Matematika i Mekhanika, 1956, Nr 5). Such a solution has proved difficult for many systems other than of the on-off type. In the present paper, another method of analysis of self-excited oscillations is presented using a Fourier expansion with a finite number of higher harmonics (including a zero harmonic in the case of non-symmetrical oscillations). The method is based on using the results of harmonic linearization considered as the zero approximation with subsequent improvements by determining the higher harmonics. The method is applicable to many systems with non-linear characteristics more general than a succession of straight line sections, but nevertheless with other substantial limitations. The general equation describing the motion of a non-linear system contains the non-linear characteristic in the form of a function of the displacement. A limitation is introduced by which the higher derivitives of this function are finite. The periodic solution of the

S/179/59/000/06/007/029
E191/E181

On the Determination of the Higher Harmonics in Non-Symmetrical Self-Excited Oscillations

equation of motion is formulated, distinguishing the zero and fundamental harmonics. It is shown that, accepting the above limitation on the non-linearity, the zero and fundamental harmonic solutions can be approximately derived from two separate equations (1.11). A condition is formulated ('the filtering property') by Eq (1.10). The degree of its fulfilment decides the importance of taking account of the higher harmonics in the desired solution. If important, an approximation for each of the higher harmonics is given. This, in turn, leads to a fresh approximation for the zero and fundamental harmonics. This improvement constitutes a significant computational advantage of the method presented here. Successive approximations can be introduced by using the corrected values of the zero and fundamental harmonics in the subsequent step of approximating the higher harmonics. Another advantage is the facility of dealing with non-symmetrical conditions which are expressed by the presence of a constant in the equation of motion. An example of the method deals with an on-off system. It is seen

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SHUVALOV, Nikolay Konstantinovich; POPOV, Ye.P., prof., doktor tekhn. nauk, retsenzent; VORONOV, A.A., prof., doktor tekhn.nauk, retsenzent; DEMCHENKO, O.P., kand.tekhn.nauk, retsenzent; MAKSIMOV, A.D., kand.tekhn.nauk, nauchnyy red.; APTEKMAN, M.A., red.; TSAL, R.K., tekhn.red.

[Systems of program control operating on a combined principle] Sistemy programmnogo regulirovaniia, rabotaiushchie na kombinirovannom printsipe. Leningrad, Gos.soiuznoe izd-vo sudostroit. promyshl., 1960. 74 p. (MIRA 13:6)
(Automatic control) (Programming (Electronic computers))

report to be presented at the 1st Intl Congress of the Intl Federation of Automatic Control, 25 Jun-5 Jul 1960, Moscow, USSR.

LERNER, A. Ya., - "The application of a self-adjusting system of automatic control"
MALOV, V. S., [illegible], A. M., and [illegible] A. - "Industrial telemeasurement systems and digital technique"
MEYEROV, M. V. - "Some peculiarities of the structure of multi-communications regulation systems"
MIKHAYLOVSKIY, V. N. - "Evaluation indexes and the possibility of increasing the quality of telemeasurement systems"
[illegible], V. V. - "Concerning the problem of established routines in automatic regulation systems"
[illegible], K. A. "Principals of construction of digital double code automatic compensators"
[illegible], Yu. I. - "Concerning the relation of systems of automatic regulation with the parameters of periodic movements"
[illegible], N. S., and [illegible], V. L. - "System of automatic control of cutting of rolled metal on a continuous bar mill with the use of digital calculating machines"
[illegible], V. M. - "Some principles of organizing systems of complex automation of large scale chemical production and optimization of these systems"
OSTROVSKIY, G. M. - "Systems of automatic regulation with intermittent change of parameters"
[illegible], V. P. - "Statistical synthesis of impulse systems"
PETROV, B. N. - "The invariant principle and its application in the calculation of linear and nonlinear systems"
PIVEN, V. D. - "The problem of autonomy in the technique of automatic control"
POPOV, E. P. - "Some problems of synthesis of automatic control non-linear systems"
PUGACHEV, V. S. - "Method of determining the optimum system with non-linear relation of the observed function with the parameters of the signal"
PUTSILLO, V. P., PETROV, V. V., [illegible], R. V., and VOLGDIN, [illegible] - "Principles of construction of a single class of extra control systems for automating production processes"
[illegible], V. N. - "The development of the theory of relay devices in the USSR"
ROZENBLAT, M. A. - "Dynamic characteristics of cores with right angle hystereses winding and their influence on magnetic boosters"
ROZONER, L. I. - "Varied methods of investigating the quality of automatic control systems"
[illegible], V. M. - "Dynamics of automatic regulation of boiler-turbine units"
[illegible], N. N., MEL'TSER, L. V., NAUMOV, A. A., [illegible], and PIVOVAROV, L. A. - "Automatic control of composition of multi-ingredient mixtures"
SHAGOVSKIY, E. S., and [illegible], V. G. - "Some results of work for the utilization of radioactive radiation for automatic control of mining machinery"
SOLODOVNIKOV, V. V., BATKOV, A. M., BABURIN, V. M., VAL'DENBERG, Yu. S., MATVEYEV, P. S., and POKROVSKIY, A. K. - "Analyses and synthesis of automatic control systems with the aid of calculating machine facilities"
[illegible], R. I., FITSNER, L. N., [illegible] - "Automatic optimizers and their use for solution of variation problems in automatic synthesis"
[illegible], S. V. - "A system of alternating current electric drives with autonomous power supply"
TAKSAR, I. M., and YANUSHKEVSKIY, V. A. - "Apparatus for technical control of production with the use of nuclear radiation"
TEODORCHIK, K. F., and BENDRIKOV, G. A. - "Methods of organizing the trajectory of roots of linear systems and qualitative determination of type of trajectory"
TSYPKIN, Ya. Z. - "Elements of the theory of digital automatic systems"
VENCHKOVSKIY, D. B., KASHIKIN, V. A., CHUGIN, Yu. I., and SHASTOVA, G. A. - "Static stability of telemeasurement"
VENIKOV, V. A. - "Interactions of a mathematical modeling and calculating technology experiment in calculating loads in electrical systems"

SOLODOVNIKOV, V.V., prof., doktor tekhn.nauk, red.; BOGOLYUBOV, N.N., akademik, red.; ISHLINSKIY, A.Yu., akademik, red.; KAZAKEVICH, V.V., prof., doktor tekhn.nauk, red.; LYAPUNOV, A.A., prof., doktor fiz.-mat.nauk, red.; PETROV, B.N., red.; POPOV, Ye.P., prof., doktor tekhn.nauk, red.; POSPELOV, G.S., prof., doktor tekhn.nauk, red.; RYABOV, B.A., prof., doktor tekhn.nauk, red.; ANISIMOV, B.V., dotsent, kand.tekhn.nauk, red.; PETROV, V.V., dotsent, doktor tekhn.nauk, red.; PLOTNIKOV, V.N., dotsent, kand.tekhn.nauk, red.; USHAKOV, V.B., doktor tekhn.nauk, red.; POLYAKOV, G.F., red.izd-va; SOKOLOVA, T.F., tekhn.red.

[Automatic control and computer engineering] Avtomaticheskoe upravlenie i vychislitel'naia tekhnika. Moskva, Gos.nauchno-tekhn.izd-vo mashinostroit.lit-ry. No.3. 1960. 489 p. (MIRA 13:7)

1. Chlen-korrespondent AN SSSR (for B.N.Petrov).
(Automatic control) (Electronic calculating machines)

PHASE I BOOK EXPLOITATION SOV/4479

Popov, Ye. P., and I.P. Pal'tov

Priblizhennyye metody issledovaniya nelineynykh avtomaticheskikh sistem (Approximate Methods for Analyzing Nonlinear Automatic Systems) Moscow, Fizmatgiz, 1960. 792 p. 10,000 copies printed.

Ed.: O.K. Sobolev; Tech. Ed.: N.A. Tumarkina.

PURPOSE: This book is intended for engineers and scientists concerned with the theory and practical applications of automatic control systems, particularly those which deal with nonlinearities in automatic control, stabilization and regulating systems, and servomechanisms. The book is also suitable for students and aspirants.

COVERAGE: The book presents a comprehensive treatment of various approximate methods for analyzing the characteristics of nonlinear automatic systems. These methods are based largely on the theoretical concepts of harmonic balance and equivalent linearization; also treated are the specialized small-parameter method and statistical linearization. A wide variety of nonlinearities is considered, and many

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31327
S/569/61/001/000/012/019
D274/D306

13,2000(1132)

AUTHOR: Popov, Ye. P. (USSR)

TITLE: Some synthesis problems of nonlinear control systems

SOURCE: International Federation of Automatic Control. 1st Congress, Moscow, 1960. Teoriya neprerynykh sistem. Spetsial'nyye matematicheskiye problemy. Moscow, Izd-vo AN SSSR, 1961. Trudy, v. 1, 389–403

TEXT: Synthesis problems are considered which can be solved by describing function technique and by statistical linearization. Two types of problems are discussed: problems related to the free motion of the system (stability, sustained oscillations, transient processes) and problems related to the system response to disturbances and controller action (steady-state and dynamic error, effect of vibration and random noise). System configuration and order of differential equations are assumed as arbitrary. Nevertheless, for convenience, a certain typical configuration is considered (shown in figures), with one- and two nonlinearities respectively.

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Some synthesis problems...

Transient processes, sustained oscillations, stability: For the case of symmetrical oscillatory processes, viz.

$$x = a \sin \psi \ , \quad \frac{da}{dt} = a\xi(a) \ , \quad \frac{d\psi}{dt} = \omega(a) \ , \qquad (5)$$

the describing function is

$$F(x) = \left[q(a) - \frac{\xi}{\omega} q'(a) \right] x + \frac{q'(a)}{\omega} px \ . \qquad (6)$$

The performance measure of the transient process in nonlinear systems of high order by means of Eq. (5) is analogous to that used in linear theory, namely the root-locus method, with the basic difference, however, that the damping factor ξ and the frequency ω are not constant, but vary with the oscillation amplitude a. From Eq. (5), the characteristic equation

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Some synthesis problems...

$$\mathfrak{Q}(p) + R(p)\left[q(a) + \frac{q'(a)}{\omega}(p - \xi)\right] = 0 \qquad (7)$$

is obtained. With the change of variables $p = \xi + j\omega$, one obtains

$$\mathfrak{Q}(\xi + j\omega) + R(\xi + j\omega)\left[q(a) + jq'(a)\right] = 0 \quad . \qquad (8)$$

Expansion in series

$$\mathfrak{Q}(\xi + j\omega) = \mathfrak{Q}(\xi) + j\omega\left(\frac{d\mathfrak{Q}}{dp}\right)_{\xi} + \frac{(j\omega)^2}{2!}\left(\frac{d^2\mathfrak{Q}}{dp^2}\right)_{\xi} + \ldots +$$

$$+ \frac{(j\omega)^n}{n!}\left(\frac{d^n\mathfrak{Q}}{dp^n}\right)_{\xi} \qquad (9)$$

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is convenient; if ξ is sufficiently small, then

$$Q(\xi + j\omega) = Q(j\omega) + \xi \left(\frac{dQ}{dp}\right)_{j\omega} . \qquad (10)$$

The methods of determining $\xi(a)$ and $\omega(a)$ from Eq. (8) differ. Four such graphic methods are considered. The graphs obtained in determining ξ and ω are called damping-measure diagrams of nonlinear transient processes. These graphs yield much information on the synthesis of nonlinear systems. By drawing up such diagrams with respect to various system-parameters, the most convenient parameters can be selected. It is noted that with small ξ, the use of Eq. (10) instead of Eq. (9) considerably simplifies the problem. Transient processes with non-symmetrical oscillations: Such oscillations are assumed to have two components:

$$x = x^0(t) + x^*(t) , \qquad x^* = a(t) \sin \psi(t) , \qquad \omega = \frac{d\psi}{dt} , \qquad (17)$$

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where x^* is the periodic component, and x^0 — the aperiodic. The describing function is

$$F(x) = F^0(x^0,a) + q(a,x^0)x^* + \frac{q'(a,x^0)}{\omega} px^* \quad , \tag{18}$$

where

$$F^0 = \frac{1}{2\pi} \int_0^{\pi 2} F(x^0 + a \sin \psi)\, d\psi \quad , \tag{19}$$

$$q = \frac{1}{\pi a} F(x^0 + a \sin \psi)\sin \psi \, d\psi \, , \quad q' = \frac{1}{\pi a} \int_0^{2\pi} F(x^0 + a \sin \psi) \cos \psi \, d\psi \quad . \tag{20}$$

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Hence,

$$\mathfrak{Q}(p)x^0 + R(p)F^0(x^0,a) = 0 \qquad (21)$$

$$\mathfrak{Q}(p)x^* + R(p)\left[q(a,x^0) + \frac{q'(a,x^0)}{\omega}p\right]x^* = 0 \quad . \qquad (22)$$

Eq. 22 permits obtaining the two variables (a and ω) as a function of x^0 and the parameter k. From

$$X(a,\omega,x^0,k) = 0 \ , \quad Y(a,\omega,x^0,k) = 0 \ , \qquad (23)$$

one obtains a(k) and $\omega(a)$ by the same methods as above. By graphic means one obtains the new function

$$F^0 = \Phi(x^0,k) \ , \qquad (24)$$

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called displacement function. This function is related to the aperiodic component (Eq. (21)). Thus, instead of Eq. (21), one obtains

$$Q(p)x^0 + R(p)\Phi(x^0, k) = 0 \quad . \tag{25}$$

The solution of Eq. (25) yields the sought-for characteristics of the transient process. Steady-state and dynamic errors: Let the nonlinear system be subjected to the disturbances $f_1(t)$, $f_2(t)$, $f_3(t)$. The system equations are

$$Q(p)x + R(p)F(x) = S_1(p)f_1(t) + S_2(p)f_2(t) + S_3(p)f_3(t) \quad . \tag{28}$$

The forced oscillations are sought in the form

$$x = A_f \sin(\Omega t + \varphi) \quad . \tag{29}$$

The describing function is set up and Eq. (28) is reduced. By assigning

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various values of A_f and Ω_f for k = const., and by calculating in each case B and φ_0 the solution to the problem is obtained and shown in a figure. (It was assumed that $f_1 = B \sin \Omega_f t$, $f_2 = f_3 = 0$.) From this solution, the steady-state error of the nonlinear system under sinusoidal disturbances can be determined. This error is nonlinearly dependent on B. If the system has self-sustained oscillations, the obtained forced oscillations will occur only under certain conditions. Further, the steady-state error is considered of a system operating under self-sustaining conditions. After transformations, the equation

$$X(A, \Omega, M, k) = 0 \quad , \qquad Y(A, \Omega, M, k) = 0 \tag{39}$$

is obtained, whence the functions $A(k)$ and $\Omega(A)$ can be found by any of the graphical methods described above. Knowing A for any M and k, one obtains

$$x^0 = x^0(M, k) \quad ; \tag{40}$$

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expressing x^0 by the gain factors of the elements, the steady-state error can be determined. It is noted that the limits of stability k of nonlinear systems can depend on M (i.e., on the external disturbance), unlike linear systems; this has to be taken into account in practice. Further, the dynamic error is found for a self-sustaining system, assuming x^0 not a constant, but a slowly changing function of time. By linearization, one obtains

$$\left[Q(p) + k_n(k)R(p)\right]x^0 = S_1(p)f_1(t) \quad , \tag{44}$$

whence linear theory can be used for the determination of the dynamic error. In many cases, a simpler solution can be obtained without determining the displacement function. Thus, for odd symmetrical nonlinearities F(x), the gain factor of the slowly varying component of the nonlinear element can be directly determined from

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$$k_u = \left(\frac{\partial F^0}{\partial x^0} \right)_{x^0=0} \quad . \tag{45}$$

Effect of vibration- and random noise: System (28) is considered. After transformations, and using Eqs. (18), (19) and (20), system (28) decomposes into two equations

$$Q(p)x^0 + R(p)F^0(x^0, A_B) = S_1(p)f_1(t) + S_3(p)f_3(t) \quad , \tag{48}$$

$$\left\{ Q(p) + R(p) \left[q(A_B, x^0) + \frac{q'(A_B, x^0)}{\Omega_B} p \right] - S_2(p) \frac{B}{A_B} \times \right.$$

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$$\chi\left\{\left(\cos\varphi - \frac{\sin\varphi}{\Omega_B}\, p\right)\right\} x^* = 0 \quad , \tag{49}$$

for signal and noise respectively. From Eq. (49) one obtains the equation for determining the amplitude A_B of the vibration at the nonlinearity input, viz.

$$A_B^2 \; \frac{X^2\left(A_B, \Omega_B, x^0, k\right) + Y^2\left(A_B, \Omega_B, x^0, k\right)}{X_s^2(\Omega_B, k) + Y_s^2(\Omega_B, k)} = B^2 \quad , \tag{50}$$

whence the displacement function

$$F^0 = \Phi(x^0, B, \Omega_B, k) \tag{51}$$

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is obtained by graphic means. In this case, the signal characteristic Φ depends not only on the form of the nonlinearity and on k (as was the case in Eq. (24)), but also on the amplitude B and frequency Ω of the external disturbance. In most cases it is possible to forego the solution of Eqs. (50) and (51). This applies in particular if Eq. (45) is used. In the case of random noises, when $f_2(t)$ represents a stationary random process with power spectrum density $s_f(\omega)$, statistical linearization is used. Thereby, Eq. (28) becomes

$$Q(p)x_M + R(p)F_M(x_M, \sigma_x) = S_1(p)f_1(t) + S_3(p)f_3(t) \quad , \tag{57}$$

$$Q(p)x_r + R(p)q_r(x_M, \sigma_x)x_r = S_2(p)f_2(t) \quad , \tag{58}$$

for the signal and the noise respectively. From Eq. (58) follows

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$$\sigma_x^2 = \frac{1}{2\pi} \int_{-\infty}^{+\infty} \left| \frac{S_2(j\omega)}{Q(j\omega) + R(j\omega) q_r(x_M, \sigma_x)} \right|^2 s_f(\omega) d\omega \quad , \qquad (59)$$

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whence the mean-square value σ_x of the random noise x_r can be graphically determined. Thereupon, the displacement function is found, which can be linearized in many cases, viz.

$$F_M = k_n(\sigma_f, k) x_M \quad . \qquad (61)$$

Introducing Eq. (61) in Eq. (57), a linear equation for the signal is obtained. Linear theory can be used thereafter, taking into account, however, that k_n changes with configuration, parameters and external noise.

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The above considerations remain valid for systems with several nonlinearities. It is noted that the method has been tested in practice and found satisfactory. There are 10 figures and 21 references: 17 Soviet-bloc and 4 non-Soviet-bloc. The references to the English-language publications read as follows: R. J. Kochenburger, Trans. Amer. Inst. Electr. Engrs. 69, part I, 1950; E. W. Grensted, Proc. Inst. Electr. Engineers, v. 102, part C, 1955.

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Card 14/14

POPOV, Ye. P.

"On Self-Adjusting Control Systems Without Sample Disturbances."

Paper presented at IFAC International Federation of Automatic Control Symposium on Self Adjusting System Theory, Rome 26-28 Apr 62

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AUTHOR: Popov, Ye.P. (Leningrad)

TITLE: On the investigation of self-oscillatory systems with logical devices

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Otdeleniye tekhnicheskikh nauk. Energetika i avtomatika, no.4, 1962, 116-121

TEXT: The author considers systems in which the control signal takes on only the values +1, 0, -1, in accordance with the logical conditions connected with the instantaneous values of the regulated coordinate and its derivatives. The steady-state in such systems is usually oscillatory, while transients are damped oscillations merging into the steady-state. In this article the method of harmonic linearization is applied to the study of such systems. While the logical conditions can frequently be described in analytic form, it is more convenient in many cases to give them graphically, as in Fig.1. Here, for example, the value +1 for the control signal is obtained when the deviation u of the

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controlled coordinate from its required value exceeds a prescribed value u_1 and, at the same time, the derivative $pu + v$ has the same sign (velocity directed towards increasing the deviation) or has opposite sign but small value. The broken line ABCD describes the stable limit cycle in the linear approximation, and methods for calculating the points ABCD are given in the paper as well as for determining the transient process to the same approximation (Fig.2). The phase plane is used here only for illustration, the method being suitable for systems of arbitrary order and is not connected with the construction of hodographs in the complex plane. There are 9 figures.

SUBMITTED: May 11, 1962

Card 2/3

32691
S/040/62/026/001/007/023
D237/D304

16.8000 (1132)

AUTHOR: Popov, Ye.P. (Leningrad)

TITLE: On peculiarities occurring upon the introduction of a small parameter in investigating non-linear oscillations in automatic systems

PERIODICAL: Akademiya nauk SSSR. Otdeleniye tekhnicheskikh nauk. Prikladnaya matematika i mekhanika, v. 26, no. 1, 1962, 62-69

TEXT: The author draws attention to a somewhat different formulation of the small parameter problem in equations of dynamics of non-linear automatic systems which may provide a basis for developing a strict theory for various widely used approximate methods of investigation of automatic systems containing strong non-linearity $y=F(x,px)$ where $(p=d/dt)$. Then the remaining equations can be reduced to a single linear equation of high order. In automatic systems non-linearities are often encountered which differ sharply from the corresponding linear function $y=k_1x+k_2px$. Also, for the x variable processes are often observed which are nearly

PUPKOV, K.A.; POPOV, Ye.P., doktor tekhn. nauk, prof., retsenzent;
BARANOVA, Z.S., inzh., red.

[Statistical calculation of nonlinear systems of automatic control] Statisticheskii raschet nelineinykh sistem avtomaticheskogo upravleniia. Moskva, Mashinostroenie, 1965 p.
(MIRA 18:4)

L 04993-67 EWT(d)/EWP(v)/EWP(k)/EWP(h)/EWP(l) GD

ACC NR: AT6016441 (A) SOURCE CODE: UR/0000/65/000/000/0338/0350

46
B+1

AUTHOR: Popov, Ye. P.; Loskutov, G. M.; Yusupov, R. M.

ORG: none

TITLE: On self-adjusting control systems without test perturbation effects

SOURCE: International Federation of Automatic Control. International Congress. 2d, Basel, 1963. Diskretnyye i samonastraivayushchiyesya sistemy (Discrete and adaptive systems); trudy kongressa. Moscow, Izd-vo Nauka, 1965, 338-350

TOPIC TAGS: automatic control theory, self adaptive control, optimal automatic control

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ABSTRACT: A self-adjusting control system is one which during operation (1) determines the dynamic characteristics of the system by automatic search or calculates them from measurements; (2) by some test determines the adjustment, parameters, or regulator structures necessary for standardizing (or optimizing) the system; and (3) carries out the adjusting, parameter, or regulator structure values derived. The literature contains very little information on the synthesis and analysis of self-adjusting control systems for essentially stationary plants, while the drawback of many proposed systems is that special test signals must be used

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ACC NR: AT6016441

to check dynamic characteristics of the signal. The present authors propose one of the possible principles for creating a self-adjusting control system for a certain class of nonstationary plants. The chief merit of the principle is that it can take into account conditions both internal (system parameters) and external (noise and control effects) in system operation. The report gives only the basic features of the proposed principle of designing a self-adjusting control system, but it is to be hoped that this principle can be applied in many cases where it is desirable to use natural oscillations of a system without introducing perturbing test signals. The general case and several particular cases are studied and some of the points involved are discussed. Orig. art. has: 28 formulas and 2 figures.

SUB CODE: 09, 13/ SUBM DATE: 29Sep65/ ORIG REF: 006

Card 2/2

ACC NR: AM6022150 Monograph UR/

Besekerskiy, Viktor Antonovich; Popov, YEvgeniy Pavlovich

Theory of automatic control systems (Teoriya sistem avtomaticheskogo regulirovaniya) Moscow, Izd-vo "Nauka," 1966. 992 p. illus., biblio., index. 15,500 copies printed.

TOPIC TAGS: automatic control system, nonlinear automatic control system, linear automatic control system, control system stability, automatic control technology, automatic control theory, programmed automatic control, digital computer, automatic control stability

PURPOSE AND COVERAGE: This book covers closely material of courses on "Automatic control theory" of schools of higher technical education. It may also be useful as a handbook or textbook by a wide circle of engineers, students, and scientists. The book was planned as a revised edition of Ye. P. Popov's book "Automatic Control System Dynamics" (Gostekhizdat, 1959), however, due to the rapid advances in the field of automatic control in recent years, it had to be entirely rewritten. Parts II, III, and IV were written by V. A. Besekerskiy and Parts I and IV by Ye. P. Popov.

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ACC NR: AM6022150

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ACC NR: AM6022150

SUB CODE: 13,09 SUBM DATE: 17Sep65/ ORIG REF: 093/ OTH REF: 007

Card 3/3

POPOV, Ye.P., inzh.; PYASTOLOV, A.A., kand. tekhn. nauk, dotsent; BANNIKOV, Yu.I., inzh.

Study of the drying of single-phase OMS transformers using a zero sequence circuit. Izv. vys. ucheb. zav.; energ. 7 no.11: 16-22 N '64 (MIRA 18:1)

1. Chelyabinskiy institut mekhanizatsii i elektrifikatsii sel'skogo khozyaystva. Predstavlena kafedroy proizvodstva i raspredeleniya elektroenergii v sel'skom khozyaystve.

POPOV, Ye.F.

Drying of the OMS-series single-phase transformers with the zero sequence current. Biul. tekh.-ekon. inform. Gos. nauch.-issl. inst. nauch. i tekh. inform. 17 no.12:38-40 D '64. (MIRA 18:3)