

**O‘ZBEKISTON RESPUBLIKASI OLIY TA’LIM, FAN VA
INNOVATSIYALAR VAZIRLIGI**

**MIRZO ULUG‘BEK NOMIDAGI O‘ZBEKISTON MILLIY
UNIVERSITETINING JIZZAX FILIALI**



KOMPYUTER ILMLARI VA MUHANDISLIK TEXNOLOGIYALARI
mavzusidagi Xalqaro ilmiy-texnik anjuman materiallari to‘plami
2026-yil 25-26-sentabr

(1-qism)

JIZZAX-2026

Kompyuter ilmlari va muhandislik texnologiyalari. Xalqaro ilmiy-texnik anjuman materiallari to'plami – Jizzax: O'zMU Jizzax filiali, 2026-yil 25-26-sentabr. 507-bet.

Xalqaro miqyosidagi ilmiy-texnik anjuman materiallarida zamonaviy kompyuter ilmlari va muhandislik texnologiyalari sohasidagi innovatsion tadqiqotlar aks etgan.

Globalashuv sharoitida davlatimizni yanada barqaror va jadal sur'atlar bilan rivojlantirish bo'yicha amalga oshirilayotgan islohotlar samarasini yaxshilash sohasidagi ilmiy-tadqiqot ishlariga alohida e'tibor qaratilgan. Zero iqtisodiyotning, ijtimoiy sohalarni qamrab olgan modernizatsiya jarayonlari, hayotning barcha sohalarini liberallashtirishni talab qilmoqda.

Ushbu ilmiy ma'ruza tezislari to'plamida mamlakatimiz va xorijlik turli yo'nalishlarda faoliyat olib borayotgan mutaxassislar, olimlar, professor-o'qituvchilar, ilmiy tadqiqot institutlari va markazlarining ilmiy xodimlari, tadqiqotchilari, magistr va talabalarining ilmiy-tadqiqot ishlari natijalari mujassamlashgan.

Mas'ul muharrirlar: DSc.prof. Turakulov O.X., t.f.n., dots. Baboyev A.M.

Tahrir hay'ati a'zolari: p.f.d.(DSc), prof. Turakulov O.X., t.f.n., dots. Baboyev A.M., t.f.f.d.(PhD), prof. Abduraxmanov R.A., p.f.f.d.(PhD) Eshankulov B.S., p.f.n., dots. Aliqulov S.T., p.f.n., dots. Alimov N.N., p.f.f.d.(PhD), dots. Alibayev S.X., t.f.f.d.(PhD), dots. Abdumalikov A.A., p.f.f.d.(PhD) Hafizov E.A., f.f.f.d.(PhD) dots., Norbekova B.Sh. p.f.f.d.(PhD) dots. Sindorov L.K., t.f.f.d.(PhD), dots. Nasirov B.U., b.f.f.d. (PhD) O'ralov A.I., p.f.n., dots. Aliqulov S.T., t.f.f.d.(PhD) Kuvandikov J.T., i.f.n., dots. Tsoy M.P., Sharipova S.F., Jo'rayev M.M.

Mazkur to'plamga kiritilgan ma'ruza tezislarining mazmuni, undagi statistik ma'lumotlar va me'yoriy hujjatlarning to'g'riligi hamda tanqidiy fikr-mulohazalar, keltirilgan takliflarga mualliflarning o'zlari mas'uldirlar.

bosuvchi emas, balki uning imkoniyatlarini kengaytiruvchi vosita sifatida qaralishi lozim [8].

Xulosa qilib aytganda, kelajak kadrlarini tayyorlashda sun'iy intellekt va raqamli texnologiyalarning integratsiyasi alohida fan kiritish bilan cheklanmasligi, balki o'rganish obyekti, ta'lim vositasi va kasbiy faoliyat vositasi sifatida butun o'quv jarayoniga tizimli singdirilishi kerak. Taklif etilgan to'rt darajali model – raqamli savodxonlikdan innovatsion yaratishgacha – bu jarayonni bosqichma-bosqich tashkil etish va har bir bosqich natijalarini baholash imkonini beradi.

Foydalanilgan adabiyotlar ro'yxati:

1. World Economic Forum. The Future of Jobs Report 2025. – Geneva: WEF, 2025.
2. O'zbekiston Respublikasi Prezidentining 2023-yil 11-sentabrdagi PF-158-son "O'zbekiston – 2030" strategiyasi to'g'risida"gi Farmoni.
3. O'zbekiston Respublikasi Prezidentining 2020-yil 5-oktabrdagi PF-6079-son "Raqamli O'zbekiston – 2030" strategiyasini tasdiqlash va uni samarali amalga oshirish chora-tadbirlari to'g'risida"gi Farmoni.
4. O'zbekiston Respublikasi Prezidentining 2024-yil 14-oktabrdagi PQ-358-son "Sun'iy intellekt texnologiyalarini 2030-yilga qadar rivojlantirish strategiyasini tasdiqlash to'g'risida"gi qarori.
5. UNESCO. AI competency framework for students. – Paris: UNESCO, 2024.
6. UNESCO. AI competency framework for teachers. – Paris: UNESCO, 2024.
7. Vuorikari R., Kluzer S., Punie Y. DigComp 2.2: The Digital Competence Framework for Citizens. – Luxembourg: Publications Office of the European Union, 2022.
8. Holmes W., Bialik M., Fadel C. Artificial Intelligence in Education: Promises and Implications for Teaching and Learning. – Boston: Center for Curriculum Redesign, 2019.
9. Zawacki-Richter O., Marín V.I., Bond M., Gouverneur F. Systematic review of research on artificial intelligence applications in higher education – where are the educators? // International Journal of Educational Technology in Higher Education. – 2019. – Vol. 16. – Article 39.

THE K2U POLAR NOMOGRAM: AN INTERACTIVE VISUALIZATION METHOD FOR REAL-TIME ASSESSMENT AND SOURCE DIAGNOSIS OF THREE-PHASE VOLTAGE UNBALANCE

Javokhir Sherbaev, Akmal Abdumalikov
Jizzakh branch of the National University
of Uzbekistan named after Mirzo Ulugbek
javokhirsherbaev@gmail.com, akmalabdumalikov6@gmail.com

Abstract: Continuous monitoring of the voltage unbalance factor K2U produces long streams of numbers that answer the regulatory question — is the 2 % normal or 4 % maximum limit of GOST 32144-2013 exceeded? — only after inspection of tables or time-series plots, and say nothing direct about where the unbalance comes from. We describe a polar nomogram in which the radial coordinate is K2U, the angular coordinate is the phase angle ϕ_2 of the negative-sequence voltage component, and the normative limits appear as concentric zone boundaries. A single glance then answers both questions at once: the distance of the operating point from the centre shows the margin to the limits, and the angular sector in which measurements cluster points to the origin of the unbalance. The method is implemented as an interactive web module with live recomputation, a history trail and a drag-to-explore inverse mode, and is illustrated on a simulated telecommunications load profile in which the ϕ_2 cluster correctly identifies the loaded phase.

Keywords: voltage unbalance; K2U; negative-sequence component; polar nomogram; power quality visualization; GOST 32144-2013; monitoring; symmetrical components.

Introduction. Voltage unbalance in three-phase networks accelerates the ageing of rotating machines, photovoltaic inverters and rectifier power supplies through the additional losses caused by negative-sequence currents [1, 2]. Regulations therefore bound the negative-sequence voltage unbalance factor K2U: GOST 32144-2013 requires $K2U \leq 2\%$ for 95 % of every week and $\leq 4\%$ at all times [3], with the measurement and aggregation procedure defined by GOST 30804.4.30-2013 [4]. A monitoring system that implements these documents emits a 10-minute aggregate stream — thousands of values per site per week. Presenting this stream to an operator is a genuine interface problem. A table answers the compliance question only after mental arithmetic; a time-series plot shows the margin to the limits but hides the second question an operator immediately asks when the margin shrinks: which phase, which load is responsible? The information needed to answer it — the complex phase of the negative-sequence component — is routinely computed and then discarded by conventional displays.

The polar nomogram. The method of symmetrical components [5] decomposes any three-phase voltage set into positive-, negative- and zero-sequence components; the unbalance factor is $K2U = |U_2|/|U_1| \cdot 100\%$, and the argument $\phi_2 = \arg(U_2)$ fixes the spatial orientation of the negative-sequence phasor. The nomogram plots each measurement in polar coordinates (ϕ_2 , K2U): the radius is the severity, the angle is the orientation. Three design elements make the display normative rather than merely decorative. First, the GOST limits are drawn as concentric zone boundaries — a green disc up to 2 %, an amber annulus from 2 % to 4 %, a red region beyond — so the operating point's zone membership is the compliance status, with no reading of axes required. Second, the current operating point is accompanied by a fading trail of recent history, which distinguishes a stationary condition from a drifting one. Third, in the inverse (“explore”) mode the user drags the operating point

and the display recomputes, in real time, a set of three phase voltages that would produce it, together with iso-K2U contours in the voltage plane — the nomogram then works backwards, from a hypothetical unbalance state to the voltages that realize it.

Source diagnosis by the ϕ_2 sector. The diagnostic value of the angular coordinate follows from elementary circuit reasoning: when the dominant cause of unbalance at a node is a single-phase load, the direction of the negative-sequence voltage it imprints is set by the phase the load sits on (shifted by the network impedance angle), and it is stable in time. On the nomogram such a load appears as a cluster in a fixed angular sector, whereas symmetric causes and measurement noise scatter the angle uniformly. Reading the sector therefore identifies the loaded phase without any additional instrumentation. Fig. 2 shows the effect on a simulated 28-day telecommunications load profile with a dominant single-phase rectifier group on phase C: the 10-minute points concentrate in a narrow sector around 318° , and the cluster, not any single value, is the diagnosis. The angular coordinate is physically meaningful only when the negative-sequence magnitude is appreciable; the implementation therefore suppresses ϕ_2 when $|U_2|$ falls below 0.1 % of $|U_1|$, where the argument degenerates into noise.

Implementation. The nomogram is implemented as an interactive module of a web monitoring platform (React front end, D3-based rendering [6]) that receives telemetry from measurement devices and recomputes the display live. The same component serves three modes: live monitoring of a connected device, replay of stored 10-minute aggregates, and the manual analyzer in which the user types or drags three voltages and watches K2U, the zones and ϕ_2 respond instantly. A camera control exports the current view as an image for reports. Fig. 1 shows the module's working view: the nomogram on the left, and the analyzer card computing $K_2U = 0.90\%$ (NORMAL zone) for the entered example 230/223/226 V. Within the broader platform the same ϕ_2 stream feeds an AI-based monitoring pipeline; that pipeline is outside the scope of this thesis.

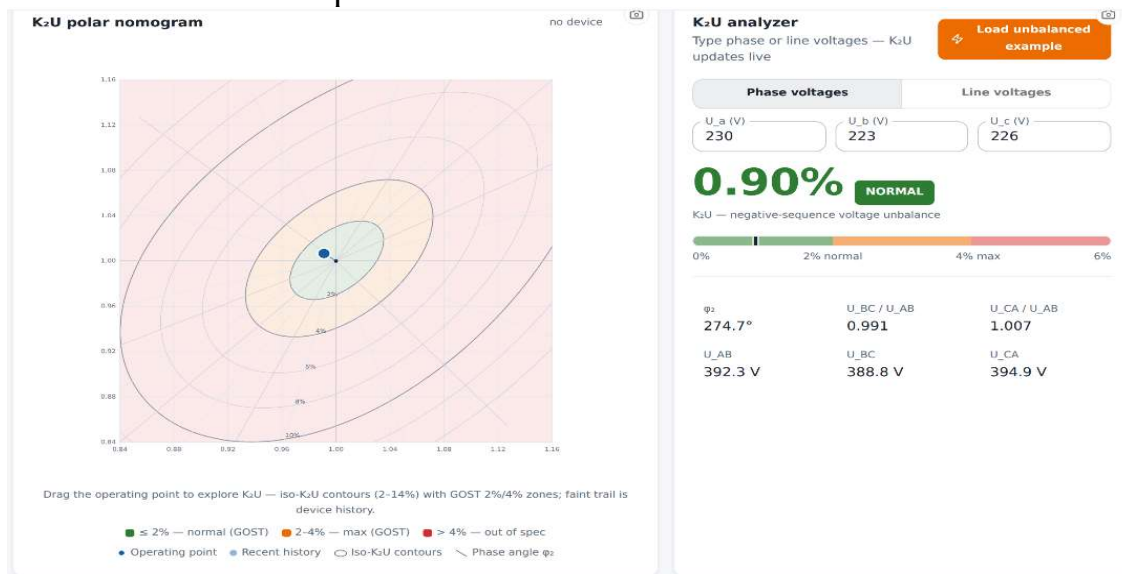


Fig. 1. Working view of the interactive nomogram and analyzer module (English interface of the web platform).

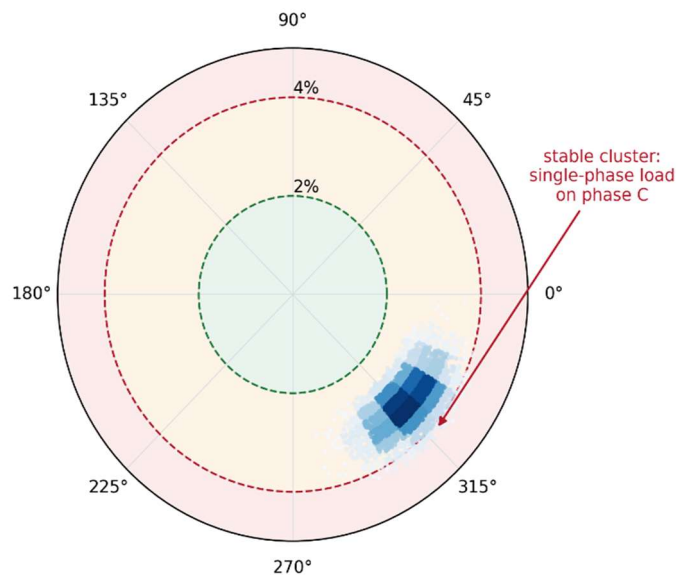


Fig. 2. Polar nomogram of a simulated telecommunications demonstration profile: the stable cluster near 318° identifies a single-phase load on phase C (demonstration stream generated by a physics-based simulator; not field data).

Conclusion. Representing the pair (K2U, ϕ_2) on a zone-annotated polar field collapses two operator questions — how severe? and from where? — into one glance at one display. Polar representations of the complex unbalance factor have been used in analysis before [7, 8]; the contribution here is their combination with normative GOST zones, a history trail and a live inverse mode in an operator-facing interactive tool that also serves as a teaching aid for the method of symmetrical components. The demonstration data shown are simulated; evaluation of the ϕ_2 -sector diagnosis on field measurements from a phasor-measuring node is in progress and will be reported separately.

Foydalanilgan adabiyotlar ro‘yxati:

1. Pillay P., Manyage M. Definitions of voltage unbalance // IEEE Power Engineering Review. — 2001. — Vol. 21, No. 5. — P. 50–51.
2. Gnacinski P. Windings temperature and loss of life of an induction machine under voltage unbalance combined with over- or undervoltages // IEEE Transactions on Energy Conversion. — 2008. — Vol. 23, No. 2. — P. 363–371.
3. GOST 32144-2013. Electric energy. Electromagnetic compatibility of technical equipment. Power quality limits in public power supply systems. — M.: Standartinform, 2014.
4. GOST 30804.4.30-2013 (IEC 61000-4-30). Electric energy. Methods of measurement of power quality indices. — M.: Standartinform, 2014.
5. Fortescue C.L. Method of symmetrical co-ordinates applied to the solution of polyphase networks // Transactions of the AIEE. — 1918. — Vol. 37, No. 2. — P. 1027–1140.
6. Bostock M., Ogievetsky V., Heer J. D3: Data-Driven Documents // IEEE Transactions on Visualization and Computer Graphics. — 2011. — Vol. 17, No. 12. — P. 2301–2309.

7. Wang Y.J. Analysis of effects of three-phase voltage unbalance on induction motors with emphasis on the angle of the complex voltage unbalance factor // IEEE Transactions on Energy Conversion. — 2001. — Vol. 16, No. 3. — P. 270–275.

8. Ferreira Filho A.L., Cormane J.A.A., Garcia D.C., Costa M.V.C., Oliveira M.A.G., Nascimento F.A. Analysis of the complex voltage unbalance factor behavior resulting from the variation of voltage magnitudes and angles // Proceedings of the 14th International Conference on Harmonics and Quality of Power (ICHQP). — Bergamo, 2010. — P. 1–7.

YER OSTI SUV RESURSLARINI BOSHQARISHDA AXBOROT TEXNOGIYALARI VA SUNIY INTELLEKT ELEMENTLARIDAN FOYDALANISH MASALALARI

Xabibullayev Ibroxim Xabibullayevich

Geologiya fanlari universiteti “GIDROINGEO instituti DM” professor, t.f.d.

Email: ibrohim5004@gmail.com

Telyaev Ismat Qudratillaevich

Mirzo ulug’bek nomidagi O’zbekiston milliy universitetining

Jizzax filiali tayanch doktoranti.

Email: ismat.telyaev93@gmail.com

Annotatsiya: Maqolada O’zbekiston Respublikasida yer osti suvlari monitoringida geoaxborot texnologiyalari (GAT) va raqamli modellashirish usullarining joriy etilishi holatini tahlil qilinib, so’nggi yillarda mamlakatda suv resurslarini boshqarish sohasida amalga oshirilgan tizimli islohotlar, xalqaro hamkorlik loyihalari va raqamli transformatsiya jarayonlari yer osti suvlarini kuzatish va boshqarishda ilg’or GATni qo’llash holatlari yoritilgan va joriy qilinayotgan “Hydromonitoring.uz” kabi ixtisoslashtirilgan axborot tizimlari, shuningdek, sun’iy intellekt va masofaviy zondlash texnologiyalarini integratsiyalash istiqbollari yoritilgan.

Аннотация

В статье анализируется состояние внедрения геоинформационных технологий (ГИС) и методов цифрового моделирования в мониторинг подземных вод в Республике Узбекистан. Освещены системные реформы в сфере управления водными ресурсами, реализованные в стране за последние годы, международные проекты сотрудничества и процессы цифровой трансформации, а также рассмотрены примеры применения передовых ГИС-технологий для наблюдения и управления подземными водами. Отдельное внимание уделено внедряемым специализированным информационным системам, таким как «Hydromonitoring.uz», а также перспективам интеграции технологий искусственного интеллекта и дистанционного зондирования.

Abstract