3. Верба І.І. Критерії визначення складу верстатного парку. / І.І. Верба, О.В.Даниленко // Матеріали міжнародної наукової конференції ”Научное пространство Европы“ (Naukowa przestrzen Europy) Секція: „Технічні науки“. Польща, Пшемисль, 7-15 квітня 2015. –с. 64-67.

УДК 621.9.06

Verba I. I., Ph.D., assistant professor
Danylenko O. V., Ph.D., assistant professor
National Technical University of Ukraine „Igor Sikorsky Kyiv Polytechnic Institute“,
verba.dan@gmail.com

WE REPAIR, MODERNIZE OR BUY NEW: "FOR" AND "AGAINST"

Now the average age of metalworking equipment is at least 20 years old and the renovation of the machine tool park is a necessary condition for the existence (and survival!) Of the enterprise in market conditions: the old machine tool is a low quality of processing, inadequate productivity, frequent repairs and simple equipment, in some cases the need for high qualification worker, etc. Reducing the volume of domestic machine tools and reducing the purchasing power of many machine-building enterprises had a negative effect on the technological environment in the country and even led to the formation of a market of equipment that was already in service and not always in satisfactory condition.

If the machine is operational, but does not provide sufficient quality of parts processing, then there are two alternative ways - modernization (possibly with simultaneous repair) of the existing machine tool or purchase of a new one. Modernization can involve both retrofitting (reassembly of a new computerized CNC instead of the old NC or CNC type), as well as the restoration of mechanical systems that are worn or outdated, as well as the complete reproduction of the machine. The average cost of repairing or updating the drive equipment is 30-40% relative to the initial acquisition cost [2] The maximum cost of upgrading should not exceed 50-60% of the cost of the new machine. The larger the machine, the more expensive it replaces the new and, accordingly, more expedient modernization. The mechanical part of the machine tools has not changed significantly over the past 20 years, but the electric is radically. The development of microcontrollers and micro-miniaturization enabled the implementation of electronic control of work and auxiliary movements and significantly improved the quality and accuracy of processing. The goal of restoring and / or extending functionality and improving the performance of the machine is achieved by restoring or upgrading its main units and systems. And since machine-building enterprises often have limited resources, the task of modernization, with the smallest possible financial costs, becomes actual.

The best option for modernization is a machine that has a slight wear and tear, high quality of the bearing system, but the control system is old and ineffective. In order to maintain the efficiency of such a management system, considerable money is being spent. Replacing the new control system gives the machine a new opportunity. When choosing a new CNC, take into account what operations the machine should do now, and which it can perform in the future. Typical factors that are taken into account when choosing a CNC: the volume of production, the complexity of processing, whether the axis C is required and whether the desired heads for rotating tools or the ability to replace the tools. According to specialists (firm CENTROID [1]), it may be economically feasible to even upgrade a machine with manual control into a fully computerized CNC machine, but this requires an analysis: the estimated computer packet is $ 8,000, its installation - another 3000 -4000 $, replacement of running screws on ball screw pairs is still 2000-3000 $. So we get a cost of $ 14000. You can buy a new machine for $ 19,000. And there may also be a need to replace the guides, for example, on a ball rail, whether the use of a linear electric motor (such a constructive decision is gaining popularity) is foreseen. That is, we see that the most frequent update of the machine is based on the use of purchased modular nodes,

which are issued by leading firms. They are quite costly, but still this value is lower, and the quality is higher than it would have been expected in the case of the production of the corresponding nodes by themselves. However, when it comes to the unique needs of the workshop, the situation is completely different: the specific features of the old machine may not be available in a new machine at a reasonable cost. For example, a through hole of a certain diameter in the spindle, a large distance between the centers, a very low transmission ratio, and so on. The comparison of the cost of acquiring a new machine with the cost of upgrading an existing one should take into account all costs, including the costs of dismantling, disabling and moving the old machine tool, and possibly its removal, the cost of transporting the new machine and associated costs, possibly - the cost of new equipment and tools, for the mastering of new skills by the workers. On the other hand, investments in PCCs are somewhat offset by increased productivity, reduced labor costs due to the introduction of unmanned technology and the servicing of several machines by low-skilled personnel.

Updating existing equipment or purchasing a new pre-careful analysis [3], which requires the use of system analysis methods (incidentally, need to be developed) for the machine tools offered on the market, and a comparative analysis of their capabilities and technical characteristics, including which CNC and software systems they need which processes are most effective and with what tools. Similarly, the ways of updating are analyzed, variants of modular nodes usage are possible, etc. So, for example, the industry is convinced that everything connected with the servicing equipment has a very high cost. About 10 years ago, one could agree with this. But today the volumes of servomotors production along with simultaneous large-scale production of components have considerably increased. This led to a significant reduction in the cost of servo drives. In a batch, with increasing demands for productivity and accuracy, as well as attention to energy efficiency and operating costs, in industries such as metal and material processing, packaging machinery, textile and food industry, welding equipment and fast loading equipment and sorting of application of servo technics is a necessary requirement. according to technological criteria and is reasonable in terms of operating costs. And also relatively recently, drives of the main movement of machines most widely used regulated DC motors. The final decision also influences economic factors. For example, in the United States it is considered inappropriate to rebuild and modernize machines worth less than $ 125 thousand: it is more profitable to buy new ones, but old ones to utilize [1].

Equipment manufacturers are interested in ensuring that users constantly update individual nodes or equipment as a whole. Modular construction method contributes to this. But there are cases where the repairs themselves have advantages, first of all it concerns even cases where repairs are cheaper and quicker than buying new equipment (the purchase of specialized technological equipment in a short time is difficult and not always a real task), and in cases where the issue relates to equipment or components whose production is discontinued or even absent for any reason on the market.

The restoration and modernization of outdated equipment are also carried out by large firms - manufacturers of such equipment, which can offer customers a wide range of options: from repairing the mechanical part with the expansion of technical capabilities to upgrading with the replacement of all mechanical and electrical components (for example, analogue drives are replaced by digital). So the choice remains for you and you do not have to rush.

List of references

1. Отремонтировать можно и 20-летнее оборудование [Электронный ресурс]. – Режим доступа http://konstruktor.net

2. Потапов В.А. Опыт американских и германских фирм по ремонту, восстановлению и модернизации станочного оборудования [Электронный ресурс]. – Режим доступа: http://stanki-katalog.ru/st_4.htm

3. Верба І.І. Критерії визначення складу верстатного парку. / І.І. Верба, О.В.Даниленко // Матеріали міжнародної наукової конференції ”Научное пространство Европы“ (Naukowa przestrzen Europy) Секція: „Технічні науки“. Польща, Пшемисль, 7-15 квітня 2015. –с. 64-67

УДК 621.767(075.8)

Пуховський Є.С., докт. техн. наук, професор
Кореньков В.М., канд. техн. наук, доцент
Розанов В. магістрант
Національний технічний університет України «КПІ ім. І.Сікорського», v.rozanoff@gmail.com

РОЗРОБКА ПОСТПРОЦЕСОРА ДЛЯ 4-ОСЬОВОЇ ОБРОБКИ НА ВЕРСТАТІ З ЧПК

Метою роботи технолога-програміста є створення файлу управляючої програми, яку виконає верстат. Однією із задач, яку потрібно вирішити на шляху до отримання NC-файлу - є постпроцесування траєкторії у відповідності до кінематики верстату.

Крім лінійних переміщень по осям XYZ, кінематика верстату дозволяє здійснювати повороти ABC навколо цих осей, як наслідок – виникає необхідність вирішення зворотної задачі кінематики (обчислення кутів повороту та лінійних переміщень по заданому положенню робочого органу і відомою схемою кінематики верстату) [1].

В даній роботі для CAM-системи Inventor HSM [2, 3] було розроблено модуль постпроцесування (рис. 1) з метою використання на токарних оброблюючих центрах HAAS.

```
function onSection(){
 var abc = machineConfiguration.getABC(currentSection.workPlane);
 setRotation(machineConfiguration.getRemainingOrientation(abc,currentSection.workPlane));
 writeBlock("G0","A" + abcFormat.format(abc.x));

 writeBlock("T"+tool.number,"S"+rpmFormat.format(tool.spindleRPM));

 xOutput.reset();
 yOutput.reset();
 zOutput.reset();
 var initialPosition = getFramePosition(currentSection.getInitialPosition());
 writeBlock("G0",xOutput.format(initialPosition.x),yOutput.format(initialPosition.y));
 writeBlock("G0",zOutput.format(initialPosition.z));
 }

function onRapid(x,y,z){
 writeBlock("G0",xOutput.format(x),yOutput.format(y),zOutput.format(z));
 feedOutput.reset();
 }

function onLinear(x,y,z,feed){
 var xyz = xOutput.format(x)+""+yOutput.format(y)+""+zOutput.format(z);
 var f = feedOutput.format(feed);
 if (xyz) {
  writeBlock("G1"+xyz+radiusCompensationTable.lookup(radiusCompensation)+""+f);
 }
```

Рис. 1 – Фрагмент програмного коду постпроцессора

У програмній частині реалізовано функції: парсингу даних CLDATA; матричні перетворення та обчислення координат траєкторії; перевірка по обмеженням верстата; формування команд на переміщення, зміну інструмента, корекцію на радіус інструмента, та обробку в циклі.

Дане рішення випробувано та впроваджено на реальному виробництві.

Список посилань

1. Молочник В. И. Проектирование постпроцессоров для оборудования с числовым программным управлением / В. И. Молочник, Г. П. Гырдымов, А. И. Гольдштейн. – Л.: Машиностроение, 1982. – 136 с.

2. Post Library for Fusion 360 and Autodesk HSM [Электронный ресурс]. – Режим доступа: http://cam.autodesk.com/posts/