Technical Information and Calculation by Access to the Internet with Mobile Telephones

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Information for electroplating technology can be obtained by some mobile telephones. The authors set up home pages of calculating surface area and thickness of electrodeposited film, rating number figures of pitting corrosion and potential pH diagrams using programming language for mobile telephones (Java2ME, etc.).

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1. Introduction

Although the use of Personal Digital Assistants (PDA) is not widespread in Japan as of this moment, the number of mobile telephones currently connected to the Internet is extremely large. The authors have written programs that can be used by engineers and personnel associated with surface treatment technology in their mobile telephones with built-in Java capability. The program has been written in "iAppli Java," a language that combines the Connected, Limited Device Configuration of Java Platform Micro Edition and a language developed by NTT-DoCoMo. This report describes the following programs:

(1) Data plotting program
(2) Calculation program
(3) Program to display graphs of functions
(4) Program to paste figures and photographs
(5) Drawing program
(6) Video program
(7) Animation program
(8) Queue simulation program using the Monte-Carlo Method
(9) Monte-Carlo simulation of pitting corrosion and filiform corrosion
(10) Accuracy of simulation by the Monte-Carlo Method

APENDIX (1);
The current state of mobile telephones in Japan

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All source programs are shown in our homepage.
http://www.mc.mat.shibaura-it.ac.jp/~master/doctor/zsa/iapplijava/contents.html

2. Data- plotting program

Personnel making rounds of the anodizing aluminum production lines may sometimes need to observe the measured data in graphical form on site. A program that plots the measured data in the x-y coordinate system was written for mobile telephones with built-in Java capability. Fig. 1 (left) shows the data input screen. Fig. 1 (right) shows the plot of data on the screen of the mobile telephone.

(A) Data input screen (B) Plotted data

Fig.1 Data-plotting

3. Calculation program

The surface area may sometimes need to be calculated for the product on which the oxide film is to be formed in the production line. In such cases, if the user downloads the iAppli Java program "Surface Area and Current Calculation" to the mobile telephone with built-in Java capability, the program can be used to calculate the surface area even while the person is making rounds of the anodizing aluminum plant. Fig. 2 shows a photograph of the screen after running this program with an emulator. The data after scrolling through a page on the screen is displayed in this figure. The "surface area of individual item" and the "total surface area" of racked products are calculated by this program. The "current value" for electrolysis of anodized aluminum at the specified current density is also calculated by the program. It should be noted that iAppli Java calculates integers only, therefore, decimal fractions need to be expressed as integers when entering the data. For instance, "1.5 A" needs to be entered as "1500 mA" and the setting switched over to "Display in Decimal Fractions of Amperes" to display the calculated results.

(A) Data input1 (B) Data input2

Fig.2 Calculation of surface area and total current

In addition to anodized aluminum treatment, surface treatment engineers working in the electroplating industry often need to use an "Electroplating Thickness Calculation" program. The program shown in Fig. 3 will be useful in this respect. The electroplating thickness is calculated based on the Faraday's Laws of Electrolysis, but values of electrochemical equivalent and specific gravity of the metal to be plated will be required. Thus, the electroplating thickness cannot be calculated using a calculator while making rounds of the production lines. However, if the iAppli Java program "Electroplating Thickness Calculation" is downloaded to a mobile telephone with built-in Java capability, then the plating thickness can be calculated while making the rounds of the electroplating plant. Fig. 3 shows a photograph of the screen after running this program with an emulator. The types of metal used for plating a surface can be selected by buttons as shown in Fig. 3(B).

(A) Data input screen (B) Data input2

Fig.3 Calculation of thickness of electroplated film.

Calculation program that can be used on site by professionals in various fields is made. A program has been written for calculating 5 sets of values (X, Y) by the method of least squares (linear approximation). Fig. 4 shows the results of running this program by an emulator.

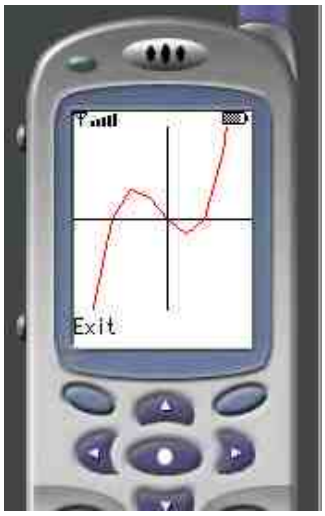
(A) Data input screen (B) calculated Result

Fig.3. The method of least squares (Linear approximation).

4. Program to display graphs of functions

iAppli Java does not contain commands for calculation of functions. Therefore, associated calculations and display of graphs of functions are performed by arithmetic operations. For instance "X^3" is calculated by multiplying X three times. Triangular functions and exponential functions are calculated by approximation using Taylor's expansion. After deciding the origin of the graph to be drawn on the screen of the mobile telephone using the coordinate origin command, the straight lines representing the coordinate axes are drawn using the straight line command. If the X values are subsequently increased using the loop command, the graph can be plotted. Fig. 5 shows graphs of quadratic and third-order functions.

(A) Quadratic function



(B) Third-order function.

Fig.5 Graphs of functions

5. Program to paste figures and photographs

To explain to persons not in this field that "aluminum oxide film is a porous oxide film with a hexagonal columnar structure," it would be convenient to show them the Keller model of aluminum oxide film, as shown in Fig. 6(A). Fig. 6(B) shows an unique agitator made in Japan recently. Fig. 7(A) shows the status of an experiment using an anodized aluminum bath containing the agitator mentioned above. It is also convenient to explain pitting corrosion that occurs on colored aluminum oxide film by showing the status of actual pitting corrosion on the screen of the mobile telephone, as shown in Fig. 7(B). To paste figures or photographs using the iAppli Java program, they should always be converted to "GIF images" and saved using the image display command.

(A) Keller model

(B) Agitator

Fig.6 Figures on the screens

(A) Anodizing tank

(B) Pitting corrosion

Fig.7 Photographs on the screen.

6. Drawing program

Information in drawings may sometimes have to be referred to by relevant personnel in the manufacturing plant or when outside the plant premises. For situations such as these, a drawing program was written that displays the steel-carbon equibrium diagram (see Fig. 8). If the telephone number button is pressed after displaying this diagram, a magnified view is displayed as shown in Fig. 9. These diagrams are drawn as a collection of short straight lines. iAppli Java does not include a command for drawing curved lines. By a similar method, the "Potential-pH diagram" of iron can be drawn (see Fig. 10(A)). If the commands for polygonal shapes and color are used to draw the diagrams, then a colored "Potential-pH diagram" of iron can be displayed on the screen (see Fig. 10(B)).

Fig.8 Steel-carbon equilibrium diagram

(A) Partial expansion 1

(B) Partial expansion 2

Fig. 9 Partially expanded diagrams

(A) Black and white screen

(B) Colored screen

Fig.10 "Potential-pH diagram" of iron

7. Video program

Two different GIF images were prepared showing the "Shaft Length and Condition of Waves on the Liquid Surface" (see Fig. 11 (A) and (B)). By processing these images using a "GIF animation software" and displaying them in the mobile telephone, the agitation of a vibration-type agitator could be displayed as an animated images. Video or animation is an effective means of explaining principles during a technical presentation or a marketing/sales demonstration.

(A) Longer shaft (B) Shorter shaft

Fig.11 Video view of agitation

8. Animation program

Fig. 12 shows the "Gerisher's electro deposition model," well known in the field of electroplating theory. When the metallic ions for electroplating are distant from the metallic substrate, they are surrounded by the chelating agent, but when they approach the substrate, the chelating agent faces one direction. As they approach closer to the substrate, the chelating agent separates from the metallic ions. This is the electro deposition model. The above-mentioned process is displayed as an iAppli Java animation (see Fig. 13). The ShortTimer command was used when writing the animation program. Documents for writing games in iAppli Java serve as useful reference documents when writing animation programs. These documents are available in the market.

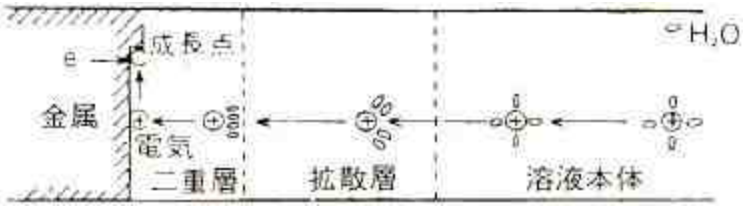


Fig.12 "Gerisher's electro deposition model,"

(A) In bulk solution

(B) In diffusion layer

Fig.13 Animation of electro-deposition

9. Queue simulation program using the Monte-Carlo Method

The method of simulating the condition of "lines" as shown in Fig. 14 and Fig. 15, is called "Queue" in probability theory and management engineering. The illustration in Fig. 14 has been extracted from the book, "Operations Research" by Hidenori Morimura and the 12th edition of the Japanese Standards Association (1997), while Fig. 15 has been taken from the website http://members.jcom.home.ne.jp/tpl-1st/outline/001_text002.htm#008. Production planning and inventory management are simulated in practice by "Queues" in management engineering. The "status of arrival of persons or trucks" and the "time devoted to offering service to the persons or trucks" in Fig. 14 and Fig. 15 are random events, and can thus be simulated by random numbers. The authors wrote a program to simulate "Queues" by the Monte-Carlo Method under the condition "one reception counter, random arrival times of persons but fixed time devoted to offering service to the persons." (Refer to Fig. 16.) Although iAppli Java has commands for calculation of real numbers only, it does have a Random command for generating random numbers, probably because random numbers are required for creating game software for mobile telephones.

Using the program shown in Fig. 16, queues can be simulated under various conditions. The authors have, however, simulated "Production Schedules" of an anodizing aluminum company that receives orders for anodizing aluminum at random intervals of time. This simulated result is shown in Fig.16.

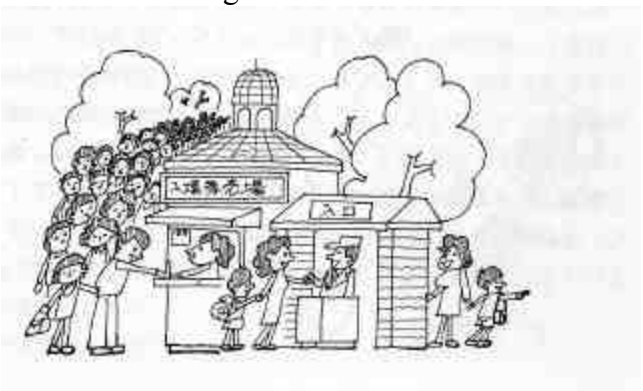


Fig.14 Illustration chart of queue (1)

Fig.15 Illustration chart of queue (2)

(A) Data input screen (B) Result of simulation

Fig.16 Queue simulation

10. Monte-Carlo simulation of pitting corrosion and filiform corrosion

Pitting corrosion sometimes occurs at random locations on anodized aluminum. This condition can be simulated by the Monte-Carlo method. If two random numbers are made to correspond to X and Y coordinate values using the Random command, random points can be plotted on the X-Y coordinate axes (see Fig. 17). Points are plotted as white and black squares. Fig. 17 shows the "Rating Number Diagram" required by JIS (Japanese Industrial Standard) for anodized aluminum corrosion tests, showing a plot of white and black squares. A state of corrosion in which large and small pits are mixed can also be simulated.

(A) A few pitting (B) Many pitting

Fig.17 Patterns of pitting corrosion by Monte-Carlo simulation

Filiform corrosion is another kind of non-uniform metallic corrosion. It is a kind of metallic corrosion that propagates in threadlike form in a zigzag direction. If the propagation of filiform corrosion in either top-right, bottom right or horizontal directions on the display screen of the mobile telephone is decided by random numbers, the results of simulation will be as shown in Fig. 18. Filifom corrosion may occur in

colored aluminum window frames in areas close to the sea, Photograph 1 shows an example of filiform corrosion observed on the anodized and colored aluminum.

(A) One corrosion (B) Many corrosion

Fig.18 Patterns of filiform corrosion by Monte-Carlo simulation

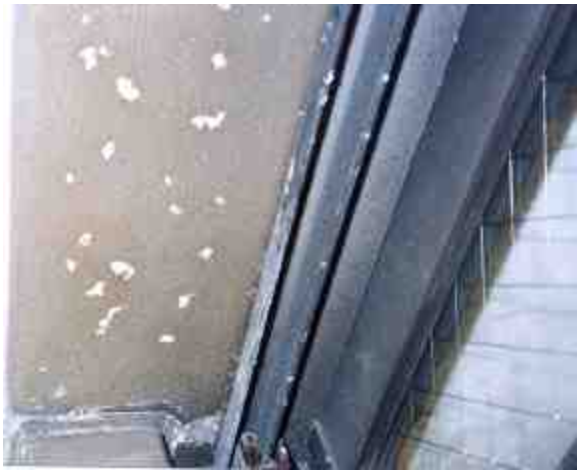


Photo.1 Filiform corrosion on anodized aluminum

11.Accuracy of simulation by the Monte-Carlo Method

The Monte-Carlo method is a technique used in various engineering and academic fields. The accuracy of the "Monte-Carlo method by iAppli Java" has not yet been verified. To verify the accuracy, the value of the ratio of the circumference to its diameter (ð) was determined by the Monte-Carlo method (see Fig. 19). The total number of points in the rectangular diagram was varied between 500 to 100,000 and simulations performed several times. The value of ð was found to be between 3.10 and 3.20.When the number of points was taken as 100,000, the mobile telephone stopped working. Thus, it was concluded that the accuracy of simulation by the Monte-Carlo method by iAppli Java was inferior to that obtained by other programming languages. Several reasons may be attributed to this inferior accuracy including error arising from taking continuous random numbers as the values of the X and Y coordinates. However, for the instances of engineering simulations mentioned above, the magnitude of the error is not of significance.

Fig.19 Value of the ratio of the circumference to its diameter (ð)

12. Conclusion

The iAppli Java programming language in its present form has many constraints, but with the progress in hardware and software associated with mobile telephones henceforth, 'ìAppli Java programs for engineers" are likely to become more effective and useful. Many of the personal digital assistants (PDA) make use of J2ME as the operating system. The iAppli Java program described in this report can be used in PDA with some modifications. According to an article in the Nikkan Kogyo Shimbun (newspaper) of December 14, 2001, NEC Software, Hokkaido, has released into the market a I-Display-for-Palm OS for browsing websites compatible with i-mode for information terminals using the basic Palm OS.

APENDIX (1); The current state of mobile telephones in Japan

This topics is described in the "Computer" page (http://computers.yahoo.co.jp/dict/mobile/phone/577.html) of Yahoo!JAPAN, a brief translation of which is given below.

First-generation telephone services (1G) using the Frequency Division Multiple Access (FDMA) technique have been offered in automobile telephones since the eighties. However, with the advent of second generation telephone services using the Time Division Multiple Access (TDMA) technology, terminals have become lighter, highly functional and more economical supporting the mobile telephone manufacturers in framing strategies for diffusion of their products and leading to an explosive increase in the number of subscribers in the nineties. The Personal Digital Communication (PDC) standards adopted by NTT DoCoMo and J-Phone are equivalent to second generation telephone services. While au started cdmaOne services that are equivalent to 2.5 generation services (2.5G) from 1998, not only did Short Message Services commence through voice and digital transmissions between subscribers , but also mail content services based on the Internet and typified by i-mode began to be offered. Thus, mobile telephone terminals are making the move from "simple mobile telephones" to next-generation information terminals at a blistering pace. The total subscriber base is currently about 70 million and has nearly reached saturation. On the other hand, services are being continually expanded, and in October 2001, NTT DoCoMo became the first company in the world to offer third-generation mobile telephone services (3G) using W-CDMA technology (FOMA). This technology offers videophone functions and video delivery functions using high speed data transfers that are faster than ISDN.The functions of the mobile telephone itself are being vastly expanded. With the start of i-mode services, mobile telephones appeared in January 2001 that could run

applications offered by content providers including simple Web browsers. Mobile telephones equipped with digital camera also appeared on the scene and the market has heated up. The rate of diffusion of mobile telephones in Japan has become extremely high thanks to the aggressive marketing strategies of the telephone companies, and the performance of these products is extremely good so much so that very few products from other countries can match them. Major carriers for mobile telephones include NTT DoCoMo from NTT, au/TU-KA from KDDI and J-Phone from the British company Vodafone.

APENDIX (2);

Source programs of i Appli JAVA

Programs are shown on the following homepage. A part of the homepage is written in English.
URL is http://www.mc.mat.shibaura-it.ac.jp/~master/doctor/zsa/index.html

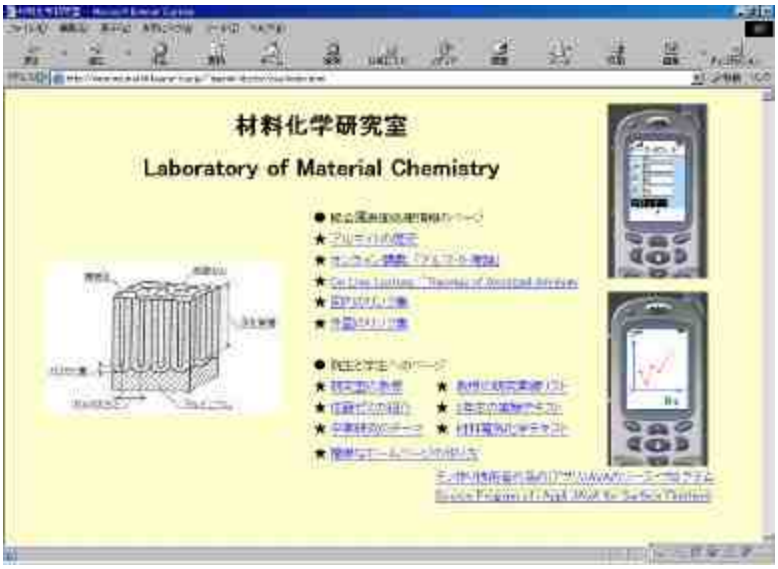


Fig.20 Homepage of source program