Assembly with Robots

TP242
O97
8566173

Assembly with Robots

Tony Owen

E8566173

Kogan Page

First published in 1985 by Kogan Page Ltd
120 Pentonville Road, London N1 9JN

Copyright © 1985 Tony Owen
All rights reserved

British Library Cataloguing in Publication Data

Owen, A.E.
Assembly with robots.
1. Assembling machines – Automatic control
2. Robots, Industrial
I. Title
670.42′7 TS178.4

ISBN 0-85038-930-5

Printed in Great Britain by
The Anchor Press and bound
by Wm Brendon & Son Ltd,
both of Tiptree, Essex

此为试读，需要完整PDF请访问： www.ertongbook.com

8556173

Contents

Preface

In the western world, economic logic (and need) has replaced the indentured craftsman by computer controlled machining centres within manufacturing industries.

The same rationale is the incentive behind the development of robots that are technically capable of performing assembly tasks, and the inevitable, albeit slow, adoption of these robots by the manufacturing industries.

This book is based upon the author's knowledge and first hand experience of the manufacturing industries of North America and the UK in general, and the UK's robotics industry in particular. The general and specific implications of performing an assembly task robotically are discussed, the majority of which are not specific to any one sector of the manufacturing industry, nor to any particular size of product being manufactured. This book should be of interest to those who are interested in or involved with the use of robots for assembly. The 'veils of mystic' and misinformation on robots and the assembly process are subsequently removed.

The author wishes to acknowledge the photographs and information provided by the following people and companies: ASEA Ltd; ASEA Robotics (Västerås); Battelle Research Laboratories; Geoffrey Champion; Cranfield Robotics and Automation Group, Cranfield Institute of Technology; Concentric Production Research Ltd; Danichi Sykes Robotics Ltd; Evershed Robotics Ltd; Fairey Automation Ltd; GEC Research Laboratories (Marconi Research Centre); George Kuikka Ltd; Dr John Hill, University of Hull; IBM UK Ltd; John Brown Automation Ltd; Martonair Ltd; Metzeler & Lord Gimetall Ltd; PA Technology; Prutec Ltd; Dr Alan Redford, University of Salford; Rediffusion Robot Systems Ltd; Sale Tilney Technology PLC; 600 Fanuc Robots Ltd; Dr Ken Swift, University of Hull; Swissap; Telelift GmbH & Co; Unimation (Europe) Ltd; VS Remek Ltd; Zentel Ltd.

此为试读，需要完整PDF请访问：www.ertongbook.com

CHAPTER 1

Introduction

Assembly with robots represents the leading edge of technological development in today's manufacturing industry. If robotics and assembly are considered separately, then assembly (as an automated process) has been in existence for almost 100 years, and robotics for about a quarter of that time. The use of robots to perform assembly tasks has been the subject of much research since the mid 1970s, but only recently has it been shown to be both technically and economically viable within the general manufacturing environment. As with advances in other technologies, the real world of industry lags far behind the frontiers of research into robotized assembly, because the 'new discoveries' need to be both proved and adapted to industry.

An assembly task occupies 53% of time and 22% of labour costs involved in manufacturing a given product. Much of today's assembly work is performed manually, or by automated machines. Manual assembly is used for low demand products and/or to perform tasks that are beyond the present capability of technology. Automated machines are used to satisfy large demand levels, and are restricted to the assembly of single groups of products.

The term 'assembly' is used here to mean the joining together of a number of discrete items to form a composite item (eg welding, screwing, glueing or fitting parts together, all of which are used in the manufacture of many of today's consumer products). However, assembly *could* also mean palletizing, in that a number of items are loaded onto a pallet in a particular arrangement until the load is completely 'assembled'.

With such a wide range of processes, the use of robots for arc welding, spot welding and pallet loading has been omitted from this book. The reasons are threefold:

1. The accuracy and repeatability of the robots (generally)

used for these tasks is in excess of the arbitrary 0.05mm limit adopted with this text.
2. The robots and control systems used for arc welding have a number of very specific requirements not applicable to other assembly tasks.
3. The major requirement for robots used for spot welding and palletizing is that of brute strength, which is not a significant criterion within the generally understood meaning of robotic assembly.

As an example of the problems of attempting to define and limit what constitutes an assembly robot, consider VS Engineering's robotic solution to the assembly of a windscreen into an automobile on the Montego line at Cowley, UK. The glass for the windscreen has to be positioned within a tolerance of 1.00mm. The total weight of gripper and the windscreen demands that a Unimate 4000, which has a repeatability of +/−2.03mm, is used. Technically, the solution can be considered to be a 'robot carried by a robot', with the Unimate being used to position roughly the gripper and glass (Figure 1.1). With the Unimate static, the intelligent gripper containing four linescan cameras, associated lighting and stepper motor systems (in addition to the vacuum cups) moves the glass vertically, horizontally and/or rotationally to match the window aperture. The gripper then inserts the windscreen into the bodyshell.

Robots have gradually evolved from primitive manipulators with virtually zero intelligence, to devices that have high levels of 'pseudo intelligence' that can communicate with other machines and react to changing work environments. The development and widespread availability of microcomputers have permitted the development of very sophisticated control and sensing systems compatible with all but the most simple of robotic devices.

Before installation, it is important to ensure that the assembly tasks are compatible with the robot's capabilities, otherwise failure both as a technical project and a financial investment will result. In addition, the product being assembled has to have been designed for automation. An automated process requires that all activities are provided with the necessary materials and that the activity is inspected to ensure that it has been performed satisfactorily at both physical and functional levels.

Although many assembly tasks can be performed by robot,

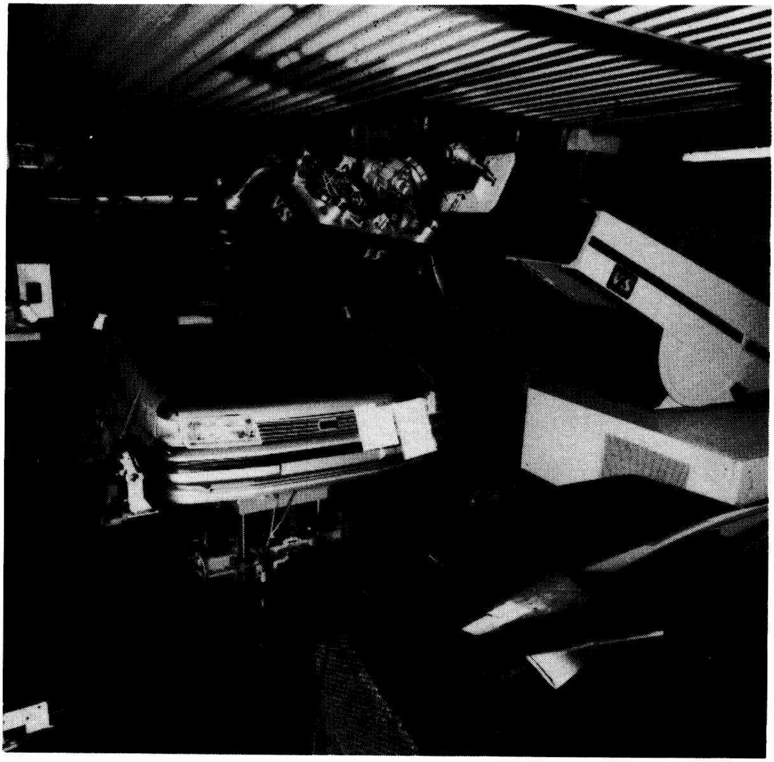

Figure 1.1 *A Unimation Unimate 4000 robot is used to assemble a windscreen into an automobile's bodyshell. The use of an intelligent gripper more than doubles the operational precision of the robot.* (courtesy of VS Engineering Ltd)

there are others that need the skills and intelligence that only man can (at present) provide. The mixing of robots and humans on an assembly line should be considered as only an extension of the interaction of men and machines in the traditional manufacturing industry. Safety is the one fundamental work difference between people and robots, which must be acknowledged and catered for in every installation.

Even though robots may be thought of as 'just' machines, they do have special features that distinguish them from other machines and make them potentially more dangerous to work with. For instance, the robot's work envelope is usually *outside* its base, making it difficult to 'visualize' the safety zone; robots are occasionally seen as 'motionless', yet without prior warning they may start moving within a three dimensional space, thus being potentially dangerous to a casual observer.

Task performance can be measured by technical achievement and economic viability. In the real world, where competitors and fractions of a penny mean the difference between profit, survival or bankruptcy, there are few circumstances where technical success takes precedence over economic sense. The economics of using robots to perform an assembly task are complex. Essentially, they involve both quantitative and qualitative values for a number of tangible and intangible benefits that *should* result from the adoption of the robotic solution.

There are many elements that make up and complicate an assembly task. Their importance to the success or failure of a project is discussed in the following chapters and appropriate observations are made.

CHAPTER 2

Why use robots?

There are a number of 'approved' definitions for robots. However, in general, a robot is a reprogrammable manipulator capable of moving various objects through variable programmed motions.

A refinement that takes into account the control sophistication of top line robots would be that 'A robot is a reprogrammable manipulator fitted with integral sensory perception that allows it to detect changes in the work environment or work condition and, by its own decision-making faculty, proceeds accordingly'.

Robot versus hard automation

It is generally considered that robots, when compared to humans, yield more consistent quality, more predictable output, and are more reliable. However, when they are compared with automated machines, then their flexibility becomes quickly apparent compared with the rigidness of hard automation. A robot is essentially an arm fixed to a base upon which it can move, the preciseness and range of motion being dependent upon the sophistication of the robot's control system. In contrast, an automated machine's motions are fixed and generally have no redundant degrees of freedom to allow it to process products outside its narrow range.

The robot's flexibility is illustrated in Figure 2.1, which shows how a 'standard' robot can be reconfigured (through specialist software and hardware accessories) to perform a vast range of tasks. It therefore makes economic sense to purchase a robot whose 'optional' features are relatively low priced when compared to the robot's base price, rather than a different, specialized machine for each task. However, the robot, being a generalist device, has many redundant links and features that result in a slower process time than a machine designed specifically for the task would take. For example, the task might require the use of only four or five of the robot's six axes of motion. Another example is where a servoed jointed arm robot is used to perform a simple straight line insertion task, instead of a single axis device.

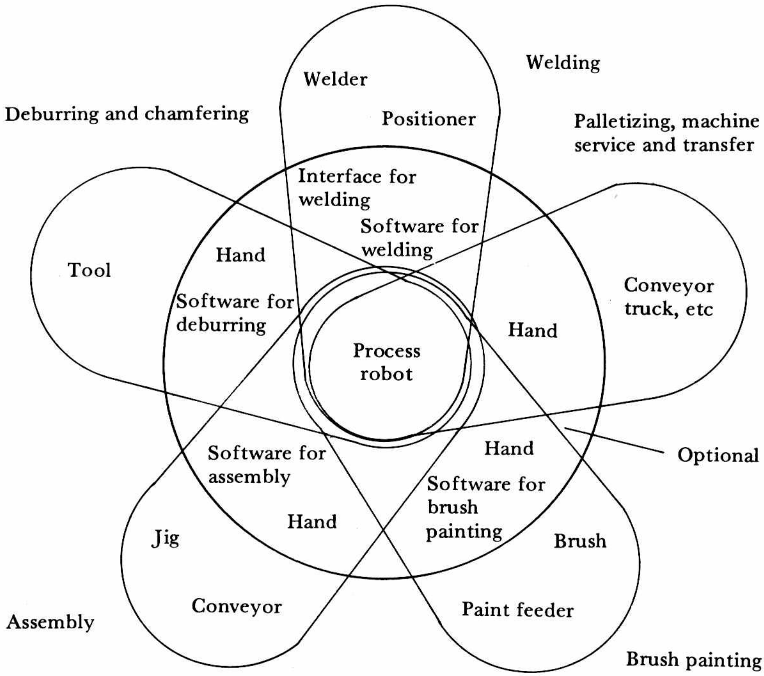

Figure 2.1 *The use of appropriate software and hardware accessories allows a 'standard' robot to be customized to a specific task. The robot's flexibility is limited only by its size, payload, repeatability and degrees of freedom.*
(from *Hitachi Review*, Vol.30, No.4, p.209, 1981)

Nowadays a typical product life cycle is generally considered to be two or three years, instead of the historical five to ten years. Consequently, many manufacturing lines will be scrapped or reconfigured after three years. A flexible system, incorporating robots, allows a higher percentage of items to be salvaged, unlike hard automation which is rarely salvageable and the return on investment (ie cost of developing and installing the system) has to be recovered before the system becomes obsolete. In addition, because the system is flexible within its

此为试读，需要完整PDF请访问：www.ertongbook.com