

Zarif Sharifovich Tadjibaev, PhD

**WORLD'S FIRST**  
**IDEAL SEWING TECHNOLOGY**  
**ZARIF 2025**

**BASED ON A ROTATING LOOPER**

**AS A BASIS FOR THE INTEGRATION**  
**OF HUMANOID ROBOTS AND THE CREATION**  
**OF AUTONOMOUS, UNMANNED**  
**SEWING PRODUCTIONS OF THE FUTURE**



**ZARIF 2025 PLATFORM**

Ideal sewing technology ZARIF 2025 + AI + Humanoid robots + Autonomous robotic carts

Ph.D. (Engineering) ZARIF SHARIFOVICH TADJIBAEV

## THE WORLD'S FIRST IDEAL SEWING TECHNOLOGY ZARIF 2025 BASED ON THE ROTARY LOOPER

### **ZARIF 2025 AS THE FOUNDATION FOR THE INTEGRATION OF HUMANOID ROBOTS AND THE CREATION OF AUTONOMOUS UNMANNED SEWING PRODUCTION OF THE FUTURE**

#### ZARIF 2025 PLATFORM

 ZARIF 2025 Ideal Sewing Technology |  Humanoid Robots

 Artificial Intelligence |  Autonomous Robotic Trolleys

*The foundation of the future automated sewing factory without personnel*

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Tashkent, 2026

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## ABOUT THIS BOOK

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The volume before you is the third book in the series *ZARIF 2025 — The Platform for Autonomous Sewing Production*. This is a major book about how ZARIF 2025 technology can become the mechanical foundation of the future autonomous sewing production, in which the human role will gradually shift from manual task execution to setting objectives, engineering supervision and strategic management.

The principal theme of this book is not merely a new sewing machine. The principal theme is the integration of four elements into a unified production platform: the ZARIF 2025 ideal sewing technology, digital control at the machine level, humanoid robot-operators, and autonomous internal logistics. It is precisely this combination that is capable of transforming the sewing shop floor from "the last stronghold of manual labour" into an industry compatible with artificial intelligence and round-the-clock robotic operation.

### IMPORTANT NOTICE

A prototype of the ZARIF 2025 sewing machine currently exists, which has practically confirmed the viability of the stitch-formation technology at speeds of up to 5,000 stitches per minute even in a very poor technical condition. Industrial machines, serial sewing automatics, integrated humanoid robots and a fully autonomous factory are at present the subject of further engineering development.

## WHO IS THIS BOOK FOR?

- Mechanical engineers and technologists in the garment industry
- Factory managers and production directors
- Investors in industrial automation and robotics
- Developers of Physical AI and machine vision systems
- Humanoid robot developers (Tesla, Figure, Boston Dynamics and equivalents)
- OEM manufacturers of sewing equipment
- Digital production transformation specialists
- All who wish to understand why genuine automation of sewing production requires not only a robot, but also the right sewing technology

## HOW TO READ THIS BOOK

The book fundamentally distinguishes between two levels of information.

### ✓ ALREADY PROVEN BY THE ZARIF 2025 PROTOTYPE

- Viability of the single-direction stitch-formation principle
- Sewing without skips, thread breaks or needle breakages
- Operation at speeds of up to 5,000 stitches per minute
- Sewing materials up to 8 mm thick with a needle bar stroke of 32 mm
- Minimum stitch length 0.5 mm
- Capability of operating with a standard single long-groove needle

### ◆ ENGINEERING CONCEPT

- Industrial version, digital control, automatic thread trimming
- Circular sewing mechanism, interfaces for humanoid robots
- Autonomous robotic trolleys and the full-scale ZARIF Autonomous Factory

These solutions are described as a realistic next stage, based on existing components, materials and digital technologies.

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## PREFACE BY THE AUTHOR

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Dear reader,

The volume before you is neither merely a technical book nor a futurological scenario. It is an attempt to describe honestly and consistently the bridge between two worlds: between modern robotics, which has already learned to walk, see and manipulate objects, and sewing production, which still rests on the mechanical principles of the 19th century.

For nearly thirty-one years, my engineering work has been connected with one principal question: is it possible to build a fundamentally different technology for straight-line sewing that simultaneously replaces

the weaknesses of the lockstitch, eliminates the constructional limitations of the traditional chain stitch, and becomes a natural platform for the operation of a humanoid robot?

The answer to this question is ZARIF 2025 technology. I deliberately distinguish in the book between what has already been proven by the prototype and what must be embodied in the industrial version. This approach is necessary not for caution, but for trust. When an engineer makes claims about the future, he is obliged clearly to indicate where the experimental fact ends and where the next implementation stage begins.

ZARIF 2025 technology is not merely a new sewing machine. It is a new language in which robots and textile production can at last speak to each other.

— *Ph.D. (Engineering) Zarif Tadjibaev, Tashkent, 2026*

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## INTRODUCTION

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### **\$2.36 Trillion in Search of a Needle**

Imagine an industry that produces goods annually to a value exceeding the GDP of most of the world's nations. An industry employing 45 million people — more than the combined population of Canada, Australia and Norway. An industry that has survived the Industrial Revolution, electrification, digitalisation and globalisation, yet has not changed its principal tool in 170 years.

The sewing industry amounts to \$2.36 trillion per year. This exceeds the combined global markets for automotive or semiconductor manufacturing. And yet 90% of all operations here are still performed manually.

Over the past 15 years, leading corporations — Adidas, Siemens, SoftWear Automation — spent more than \$220 million on attempts to automate sewing production. The result? Not a single successful, scalable model. The answer you will find in this book is striking in its simplicity: **the problem was not with the robots, but with the sewing machines themselves.**

All existing industrial sewing machines — whether lockstitch (type 301) or traditional chain stitch (type 401) — were invented in the 19th century. They were designed for human hands, for human intuition, for the human ability to feel the fabric, adjust tension and change the bobbin in time.

### **The Three Pillars of the Autonomous Factory of the Future**

- **ZARIF 2025 technology** — the world's first robot-native sewing mechanism
- **Humanoid robots** (Tesla Optimus, Figure AI, Boston Dynamics) — which at last receive a tool compatible with their capabilities
- **Artificial intelligence and digital logistics** — machine vision, predictive maintenance, decentralised autonomous trolleys

This book is neither fiction nor a marketing brochure. It is an engineering chronicle of a 31-year journey from idea to working prototype, and simultaneously a technical plan for transforming that prototype into an industrial revolution.

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# PART I

## THE DIAGNOSIS: WHY TRADITIONAL SEWING IS INCOMPATIBLE WITH AUTONOMY

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### CHAPTER 1. THE SINGLE-NEEDLE SEAM: THE INDISPENSABLE FOUNDATION AND ITS HIDDEN VULNERABILITIES

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*Why the single-needle seam rules the industry — and why it is also the principal barrier for the robot*

Single-needle sewn seams — type 301 (double-thread lockstitch) and type 401 (double thread chain stitch) — account for more than 70% of all machine sewing operations in the world's light industry. No other type of stitch has such wide and universal application. It is precisely these seams that provide the joining of garment components, footwear, leather goods, technical textiles and many other products.

Single-needle seams are used universally: garment assembly (side seams, shoulder seams, sleeve insertion, waistbands, hem); household textiles (bed linen, curtains, tablecloths, towels); furniture and interiors (upholstery, automotive and aviation seats); technical textiles (workwear, PPE, tents, seat belts, fire hoses); bags, luggage and footwear (structural seams, straps, shoe uppers); medical textiles (surgical gowns, drapes, masks); sportswear and equipment.

#### 1.1. Extreme Operating Conditions of Single-Needle Machines

Sewing machines performing single-needle sewn seams operate under significantly more complex and demanding conditions than machines using other stitch types. This is because they are compelled to process an extremely wide range of materials and situations:

Challenging Condition	Description of the Problem	Typical Applications
Varying material thicknesses and densities	Machine must adapt to fine silks (30–50 g/m <sup>2</sup> ) and heavy technical fabrics (>500 g/m <sup>2</sup> ) without adjustment	Clothing, technical textiles, upholstery
Thickened seams	At intersections of several fabric layers, thickness may increase 4–8 times compared with the base material	Jeans, jackets, workwear
Textile + leather	Different friction coefficients, stiffness, compressibility — needle must penetrate both materials equally well	Footwear, bags, belts, car seats
Textile + plastic/PVC	Plastic does not compress; requires high needle precision and special presser foot pressure	Waterproof clothing, covers, sportswear
Textile + plastic zips	Rigid toothed tape adjacent to elastic fabric — risk of skipped stitches and needle breakage	Jackets, trousers, bags, covers
Knitwear and its combinations	High stretch requires precise thread tension control; unstable fabric shifts under the presser foot	Sportswear, underwear, hosiery
Varying stiffness and elasticity	Simultaneous sewing of stiff and elastic material creates uneven feed and seam deformation	Swimwear, bodysuits, garments with elastane inserts

Under such conditions, a single-needle sewing machine must provide the highest reliability, stable seam quality, and the absence of skipped stitches, thread breaks, needle breakages and tip deformation. Unfortunately, as we shall see in the following chapters, modern industrial machines operating on the basis of traditional lockstitch (type 301) and chain stitch (type 401) technologies are incapable of fully satisfying these requirements. It is here that ZARIF 2025 enters the scene.