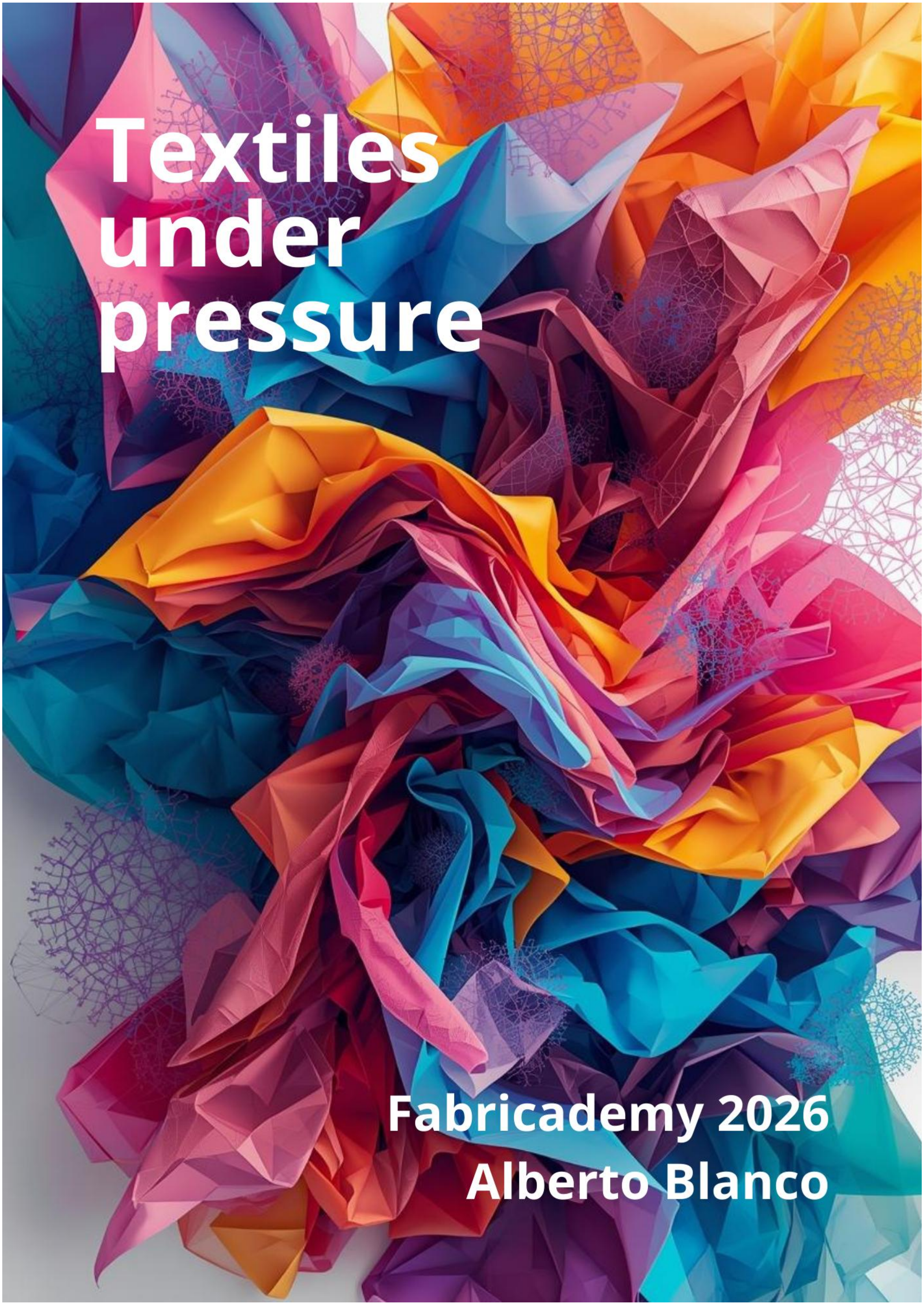

Textiles under pressure

Fabricademy 2026
Alberto Blanco

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Introduction

What is this booklet about?

This booklet is a practical and exploratory guide to **inflatable textiles**: materials that hold air, change form, and expand (no pun intended) the possibilities of what textiles can do.

Rather than presenting a single product or solution, this is a **reference tool**. It can be read linearly from beginning to end or consulted selectively. Designers, engineers, artists, and researchers can use it to understand existing approaches, test new ideas, and adapt inflatable textile systems to their own contexts.

The booklet is structured around three main sections:

- **Research**, which maps materials, fabrication methods, and existing applications
- **Experimentation**, which documents hands-on testing, successes, failures, and iterations
- **Results**, which synthesize findings into transferable insights and design considerations

This is not a manual that prescribes a single “correct” way of working with inflatable textiles. Instead, it is an invitation to **experiment, adapt, and reinterpret**.

What are inflatable textiles?

Inflatable textiles are textile-based structures designed to **contain air as an active material**. Through inflation and deflation, these textiles can change volume, stiffness, insulation capacity, or shape.

Unlike traditional textiles, which are largely passive, inflatable textiles behave as **dynamic systems**. Air becomes a design parameter: invisible, lightweight, and responsive. By controlling how air is contained and distributed, it is possible to create textiles that adapt to environmental conditions, body movement, or functional requirements.

At a basic level, inflatable textiles rely on:

- Flexible materials capable of sealing air
- Methods of bonding or joining textiles into chambers
- Internal or external mechanisms for introducing and releasing air

From these simple principles, a wide range of behaviors and applications emerge.

Inflatable textiles have been explored across multiple disciplines:

- **Apparel and wearables**, where air provides adjustable insulation, cushioning, or fit
- **Medical and therapeutic uses**, such as compression, pressure distribution, or support
- **Architecture and spatial design**, through lightweight, deployable textile structures

- **Soft robotics and interaction design**, where inflation enables movement and actuation
- **Outdoor and technical equipment**, prioritizing weight reduction and adaptability

What unites these applications is the use of air not as a byproduct, but as a **functional material,** one that can be shaped, controlled, and designed.

Brief history

The idea of using air to shape flexible materials predates modern textiles. Early inflatable structures appeared in maritime and military contexts, where buoyancy and rapid deployment were critical. Rubberized fabrics and coated textiles enabled the first air-filled shelters, life rafts, and protective systems.

In the second half of the 20th century, inflatable architecture and experimental design movements began to explore air as an expressive and structural medium. Artists and architects used inflatables to challenge ideas of permanence, rigidity, and scale.

More recently, advances in material science, digital fabrication, and soft robotics have reintroduced inflatable systems into contemporary design practice. Lightweight coatings, precise heat-sealing techniques, and embedded electronics now allow inflatable textiles to move beyond novelty and toward **functional, repeatable systems**. Today, inflatable textiles sit at the intersection of fashion, engineering, and interaction design.

This research project is a work in progress and will continue to be so.

Research

This section lays the foundations for all the experimentation and results that follow. Before inflating, sealing, or testing anything, it is necessary to understand **what has been done, what materials are available,** and **how air behaves when trapped inside textiles**.
The performance of these textiles depends not only on the textile itself, but on the material, how it is sealed, and how it responds over time.
With this section we build a framework that will be tested, challenged, and expanded.

State of the art

This is a *snapshot* of how inflatable textiles are currently used, researched, and commercialized. The goal is not to replicate the existing solutions, but to analyze and identify patterns, materials, and design strategies, as well as their limitations.

By mapping what already exists, this research establishes a point of reference from which new experiments can diverge.

Architecture

Inflatable structures in architecture are not something new; this technique has been experimented with since the popularization of commercial polymers. Some interesting examples of this use are documented below.

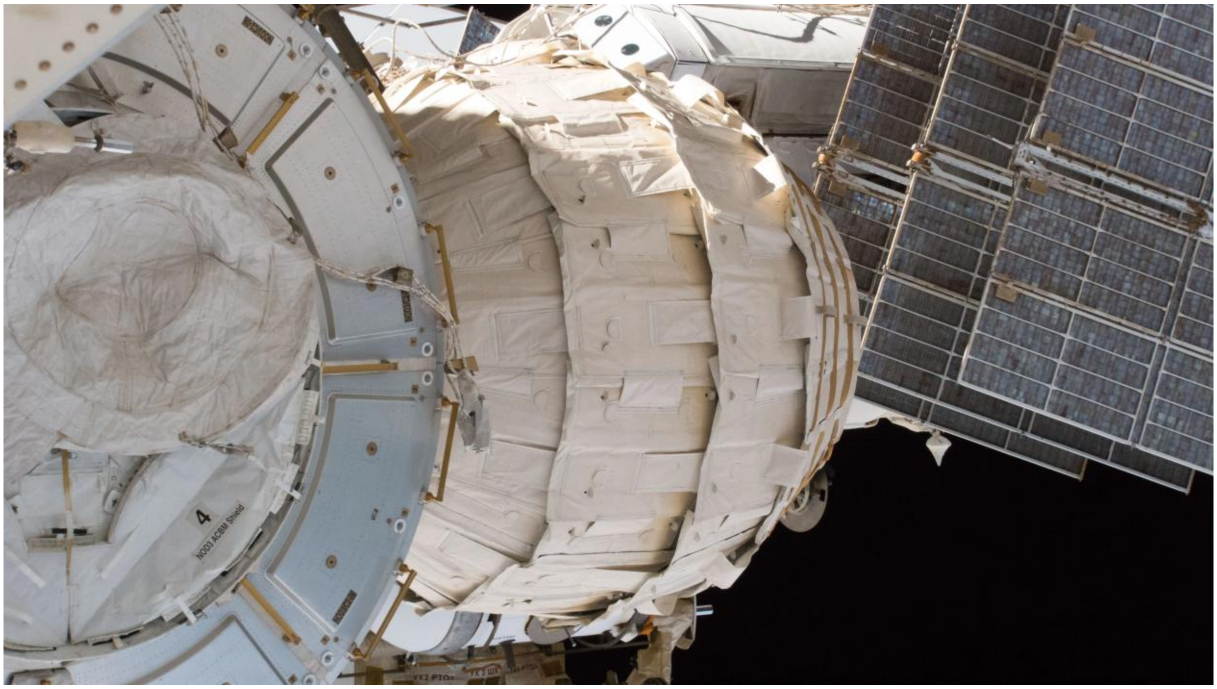
Binishells
The architecture firm uses inflatable "balloons" for creating the negative space inside of a house, then it is covered with a hardened mixture, thus creating organic shapes for habitable space. One of the most famous examples of this firm is Robert Downey Jr.'s home in Malibu.

ETFE Cushions

Ethylene Tetrafluoroethylene membranes are sealed and pressurized for its use on modern architecture. They provide high light transmision, great thermal insulation, low structural weight, and long durability. Currently used at the **Allianz Arena,** for example.

Ant Farm collective

This group of architects and artists are considered pioneers in the use of inflatable structures as tools for cultural critique, and architectonic experimentation. Mostly active between the 60s and 70s. Their Publication **Inflatocookbook (1971)** included accesible methods for designing and constructing temporary architectual structures, emphasizing lightness, movility and the ephemeral nature of these spaces.



NASA's Bigelow Expandable Activity Module (BEAM)

This project is an inflatable module that was coupled to the International Space Station in 2016. It was designed to be expanded once it reached orbit, and it's a clear example of how inflatable structures can offer resistance, insulation and protection in extreme environments.

Mark Fisher

Designer and architect specialized in inflatable structures and sculptures for scenography and great-scale concerts. He worked with the stage design and fabrication for U2, Pink Floyd, Roger Waters, The Rolling Stones, Cirque du Soleil, Elton John, Lady Gaga, Madonna, Metallica, among others.

Fashion

Inflatable textiles have expanded (no pun intended) the boundaries of fashion by introducing air as a structural and expressive material. Beyond spectacle, inflatable wearables explore themes of protection, portability, adaptability, and the relationship between the body and temporary architecture. Advances in lightweight coated fabrics, compact air pumps, and heat-sealing technologies have enabled garments that can expand, contract, and reshape dynamically, turning clothing into responsive systems rather than static forms.

Anrealage “WIND” Inflatable Jackets

Japanese designer Anrealage created garments with built-in fans that inflate parts of the textile to transform silhouette and function

Fredrik Tjærandsen Balloon Dresses

Graduate fashion shows have featured inflatable “balloon dresses” that expand with air for dramatic, sculptural runway pieces.

Diesel & Dingyun Zhang Inflatable Style Pieces

Fashion brands have produced inflatable while-wearable items as statement pieces or runway art, exploring air as shaping and expressive material.

"Sleeping Bag Dress" by Ana Ręwakowicz

An early conceptual piece that can inflate to transition from wearable garment to sleeping module — merging clothing and temporary shelter.

Inflatable Custom Apparel for Luxury Fashion Houses

Specialized studios design bespoke inflatable fashion garments that act as couture show pieces and explore structure through pressurization.

Sports

Pneumatic structures provide temporary or semi-permanent facilities such as covered courts and training domes, while high-pressure textile technologies allow rigid inflatable equipment that rivals traditional solid materials. Inflatable systems also enhance athlete safety through cushioning and airbag-based protection. The field combines material engineering with ergonomic design to create adaptable environments and equipment that optimize performance, reduce injury risk, and simplify transport and installation.

Nike Therma-FIT ADV Repel Down Jacket Milano
A performance winter jacket that uses air-trapping baffle structures to enhance insulation while reducing weight. Though not visibly "inflatable," its sealed chamber construction mirrors pneumatic textile engineering used in technical sportswear.

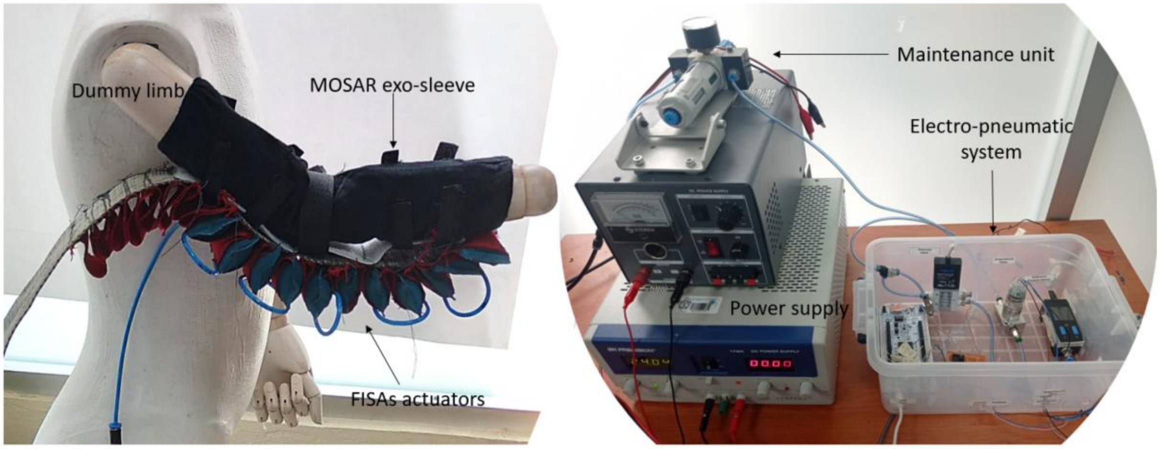
Dainese D-air Racing Suit
A professional racing suit with integrated inflatable airbag textiles that deploy instantly during crashes, protecting critical body areas without restricting movement during normal use.

Alpinestars Tech-Air System
A wearable airbag vest worn under racing suits that inflates in milliseconds upon detecting impact, using sealed textile chambers designed for flexibility and high tear resistance.

Helite Airbag Vest
An inflatable protective vest used in equestrian and extreme sports that deploys upon sudden separation from the saddle, cushioning the torso and spine using pneumatic textile structures.

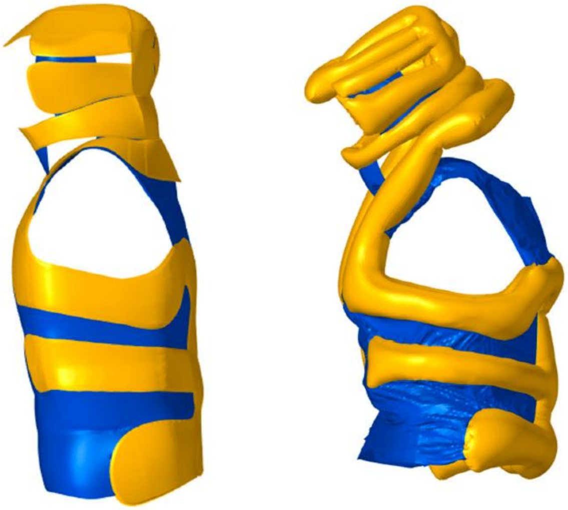
Medicine

Medical applications of inflatable textiles focus on adaptability, softness, and safe interaction with the human body. Pneumatic textile systems can conform to anatomical shapes, distribute pressure evenly, and provide adjustable support, making them ideal for rehabilitation devices, assistive wearables, and patient positioning systems. Their compliance allows movement assistance without rigid mechanical components, improving comfort, and reducing injury risk.



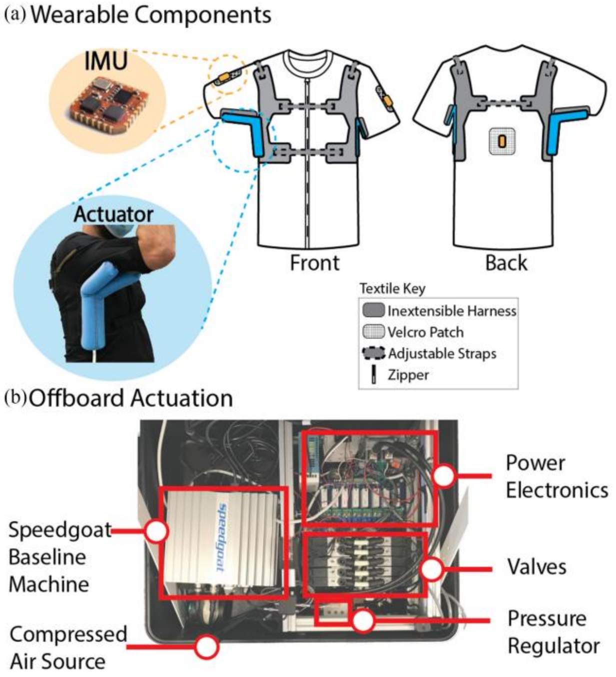
Wearable Soft Pneumatic Actuators for Rehabilitation

Fabric inflatable actuators can assist limb movement in soft robotic exo-sleeves used for rehabilitation or mobility aid.



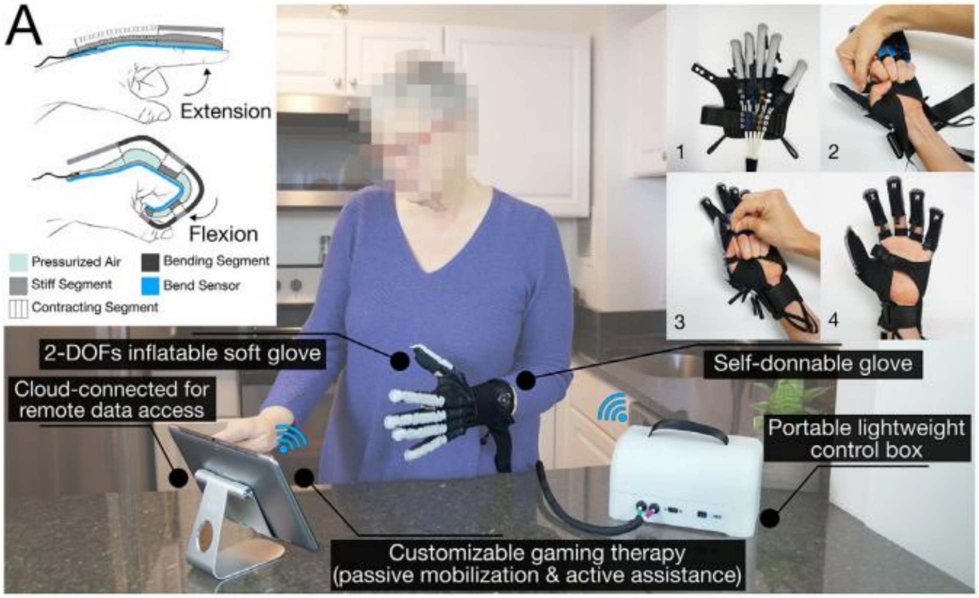
Wearable Airbag Protection Systems

Medical-inspired wearable airbags (e.g., protective jackets/helmets) can inflate upon sensing impact to protect the wearer's head and torso in injury scenarios.



Textile Inflatable Actuators for Shoulder Assistance

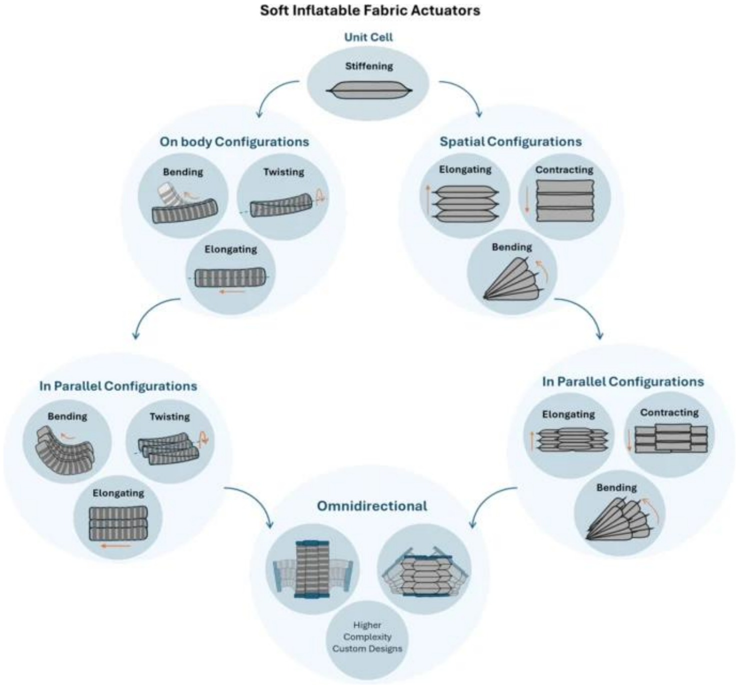
Textile pneumatic actuators integrated into wearable garments can reduce muscle activation in assisted movement therapy.



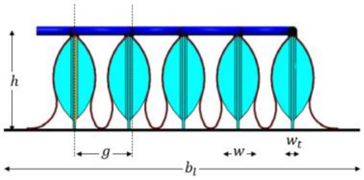
Soft Inflatable Glove Devices for Hand Rehabilitation
Soft fabric actuators within gloves can pneumatically assist hand extension/flexion during therapy and recovery.

Soft Robotics

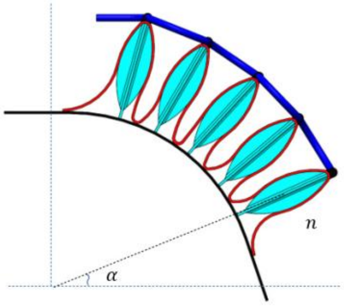
Soft robotics use inflatable textiles to create lightweight, flexible mechanisms that mimic biological movement. Instead of rigid joints, pneumatic chambers embedded in fabrics generate motion through controlled air pressure, enabling bending, twisting, expanding, and contracting behaviors. Textile-based inflatable actuators are safer for human interaction, adaptable to irregular surfaces, and easier to fabricate than traditional robotic systems.



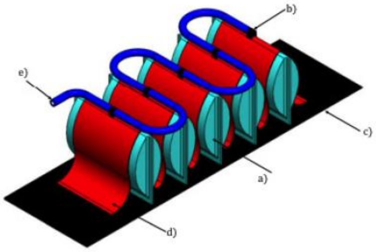
Unified Framework of Soft Inflatable Fabric Actuators
Research demonstrates modular inflatable fabric actuators that bend, contract, and move — a key soft robotics approach.



(**a**) Front view of FISAs design.



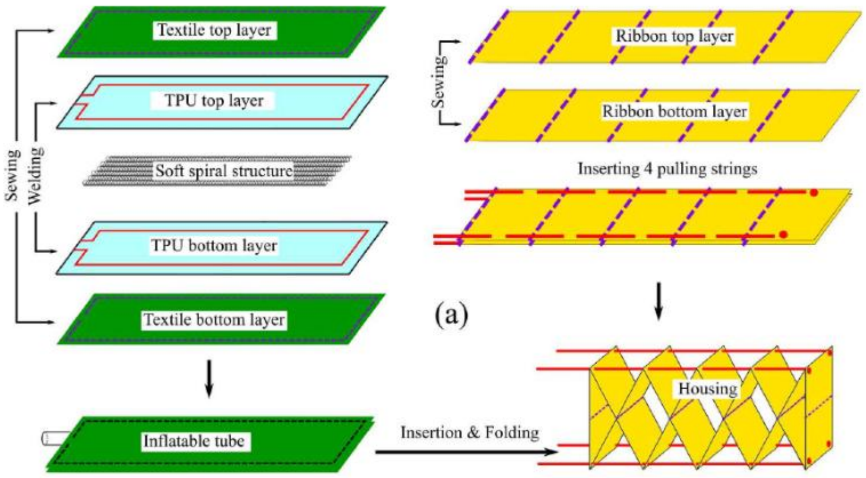
(**b**) Side view of FISAs design.



(**c**) Isometric view of FISAs assembly.

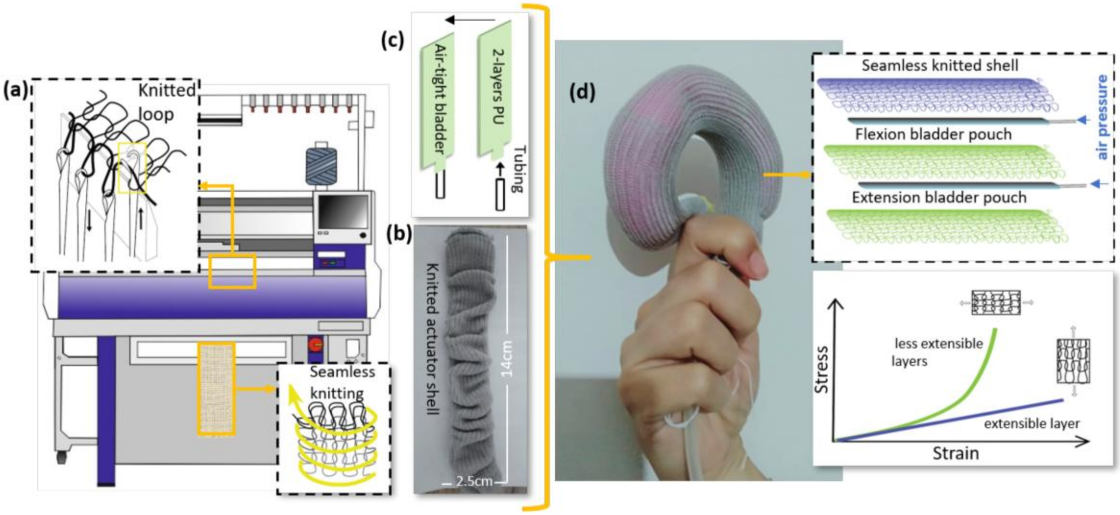
MOSAR Fabric Inflatable Soft Actuators for Wearables

Fabric pneumatic actuators form modular bending/extension mechanisms used to assist motion in soft wearable robotics.



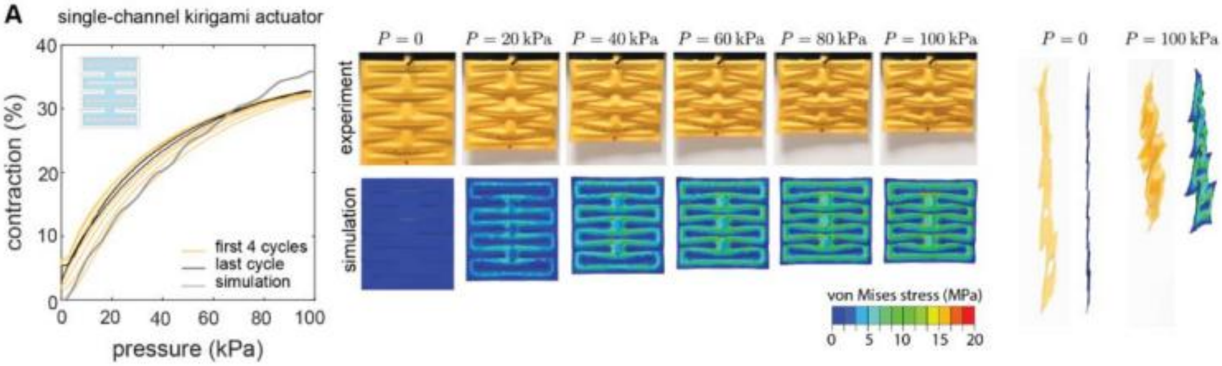
Marionette-Based Programmable Textile Inflatable Actuators

Programmable inflatable textile actuators that change bending and twisting behavior using tensioned textiles.



Knitted Pneumatic Textile Actuators for Wearable Robots

Machine-knitted inflatable actuators deliver bending motion while conforming to the body for assistive robotics.

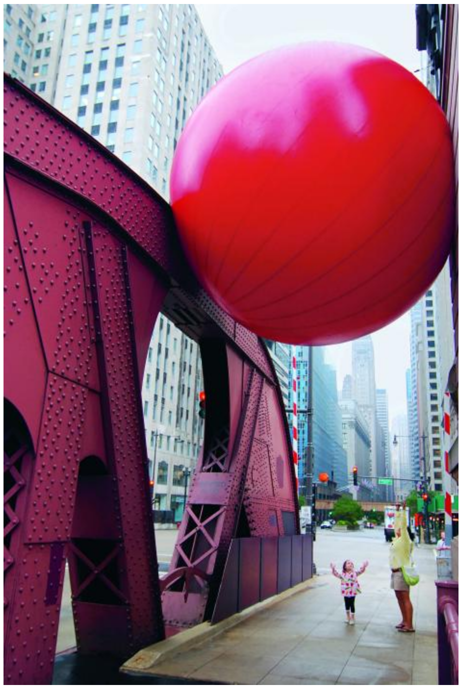


Inflatable Kirigami Crawlers

Innovative research combining kirigami cuts with inflatable textiles to create textile actuators capable of locomotion.

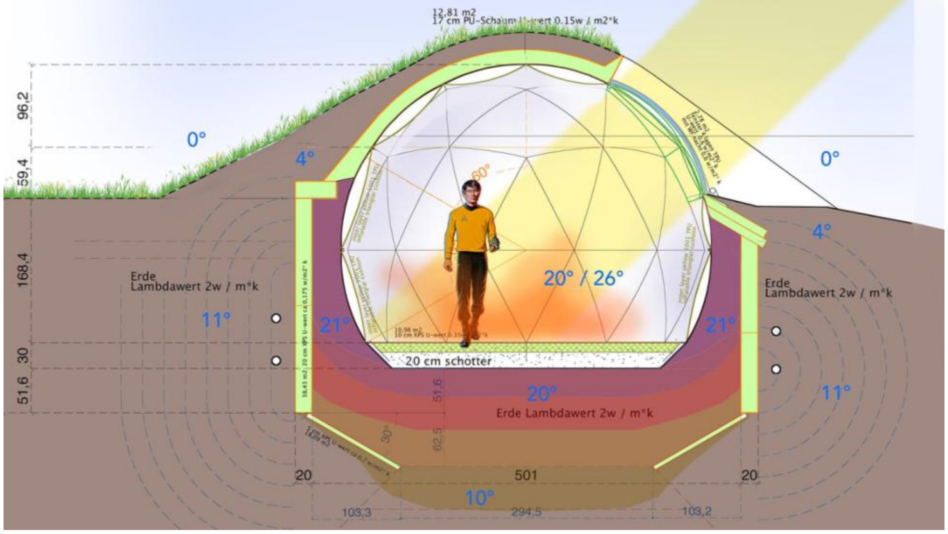
Art

Artists and designers employ inflatable textiles to explore scale, temporality, and audience interaction. Air-filled forms transform spaces rapidly, creating immersive installations, kinetic sculptures, and participatory environments that challenge perceptions of mass, permanence, and materiality. Because inflatable structures are lightweight and transportable, they enable large-scale interventions in public spaces and temporary exhibitions.



Bubbletecture Work & RedBall Project

Artists such as Kurt Perschke create inflatable interventions (“Bubbletecture”) that use air-filled balloons and textiles as large public art.



Pneumocell

Large inflatable textile installations provide interactive art experiences in urban environments and festival contexts.

Temporary Inflatable Art Pavilions
Inflatable textile spaces used as pop-up galleries or interactive art pavilions explore form and spatial experience.

Inflatable Latex Sculptures by Sasha Frolova
Contemporary artists use inflatable latex/textile sculptures as expressive forms often exhibited in galleries and public spaces.

Materials

The materials that were chosen for this experimentation must be:

- Easy to find
- Non-expensive

- Standardized

So, this is the selection of materials:

- LDPE – As in dog litter bags
- HDPE – As in heavy duty trash bags
- Textile vinyl – That adheres with heat
- Crystal PVC
- Satin Fluorescent PVC
- Soft transparent PU – As in transparent curtains
- RipStop (cotton – polyester blend + PU) - As in camping tents
- Mylar – As in emergency blankets
- PolyPropilene + aluminum – As in Chip bags

Sealing methods

The purpose of these techniques is, on one hand, capture air between the layers, and on the other hand, preventing it from escaping. This can be done through heating, adhesives, and mixed techniques.

Heat

The purpose of this book is to experiment with heat-sealing methods for different materials, all done through means of digital fabrication.

Laser

Using a laser cutter, it is possible to weld different layers of thin materials. Special thanks to Saskia Helinska and Javier Alboguijarro, whose previous research helped and inspired me a lot on this topic.

Fusing with ironing.

Using the heat press we can fuse different layers of materials, and with a "isolating" material in between, it is possible to do it in specific parts, so the result behaves like we want to.

3D printer hot-end fusing

With "Cheating" the 3D printer, it is possible to use the hot-end to fuse layers of materials in specific areas.

Valves

By using off-the-shelf check valves, it is possible to increase the air retention time and capacity of the materials.

The book

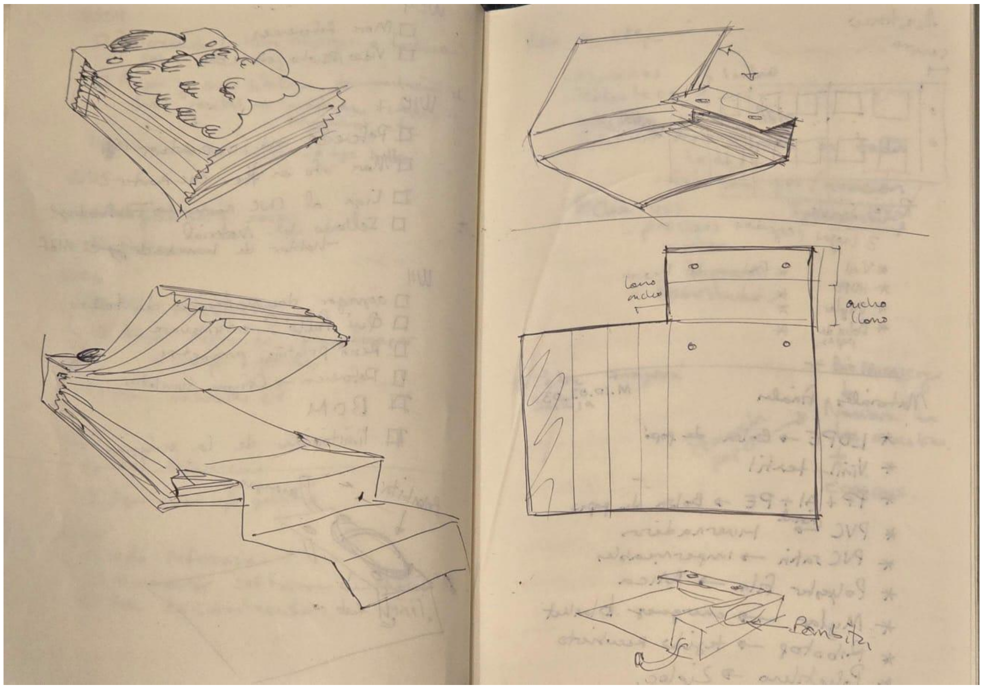
This book is a tool, rather than a finished product. It is meant to exist somewhere between a reference manual, a material archive, and an experimental catalogue: a space where inflatable textiles can be explored not only through observation.

One of the biggest challenges I stumbled upon when approaching inflatable textiles was that the design process is not very clear from the beginning. We can start with a sketch for the form and behavior we want but translating that idea to a prototype means hours of experimentation, trial and error that revolve around materials, sealing methods, air distribution, and in general fabrication limitations. This book was developed as a way to navigate those uncertainties.

This project does not present a single “correct” method, but rather proposes a starting point for experimentation. It offers references, examples, and fabrication methods that can help the user, maker, designer, or researcher, understand how different materials and processes shape the behavior of inflatable structures. The intention is not to provide “definitive” answers, but to encourage testing, failures, learning, iteration, and documentation.

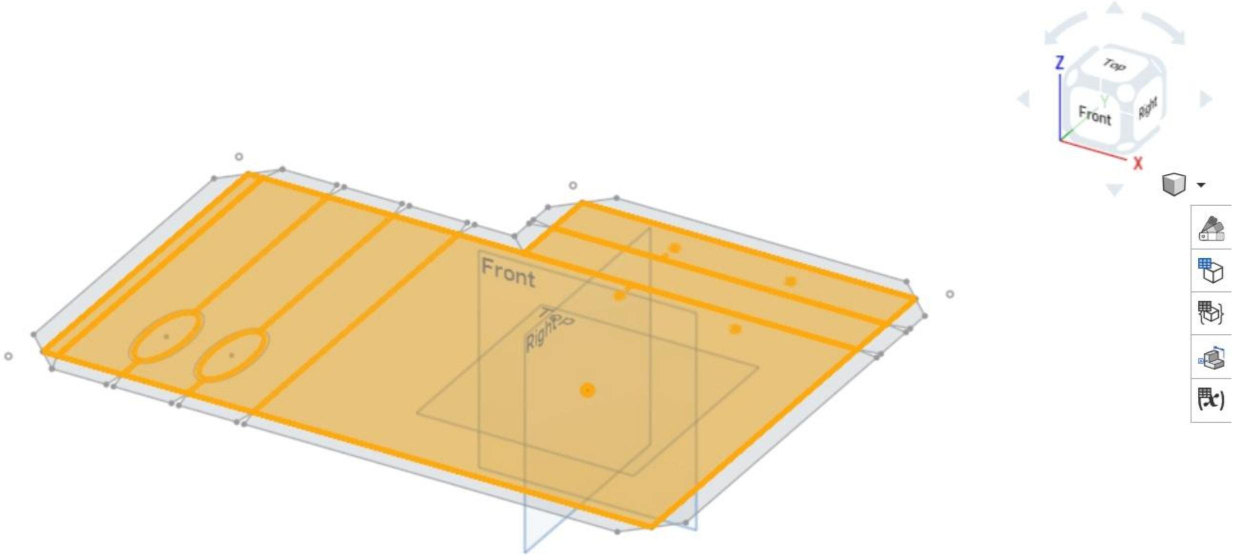
The design

The most important aspect of this project, beyond the informational content, is the interactive experience. Each sample explains the behavior of the material, the geometry and the process, in an honest and straightforward manner, by using the integrated hand pump, upcycled from an old blood pressure monitor.



Replicability

This publication is meant as a platform for distributed knowledge. It is encouraged to replicate the book, but also to document their own experiments, adapt the workflows to the locally available materials, machines and tools, complement the information available, and share their findings with the rest of the community. Hopefully, through this interaction, this project will become part of an open and evolving ecosystem / community / platform.



Experimentation

We now have the theoretical idea of which materials, processes, and machines are to be used; it is time to translate the knowledge into physical experimentation. Instead of trying to pursue a single "perfect" outcome, this part must be approached as a process of testing, observation, documentation, and adaptation to the local resources.
This hands-on approach is aimed at evaluating how different materials, sealing methods, geometries, and fabrication workflows influence the behavior of the inflatable structures, and to challenge the user to think outside of the box to achieve results.
The following sections document the process of these experiments with materials, fabrication methods, and designs. The results are presented comparatively in order, to understand the relationship between the parameters.

Sealing

The principle for inflatable textiles is relatively simple, with the ability to contain air with properly designed structures, that is, **sealing**. Of course materials define great part of the behavior of the final product, but the sealing methods are the "controllable" part that we can design and leverage them to achieve the results we expect.

Industrial sealing often relies on specialized technologies like ultrasonic sealing, or industrial high-pressure, high-heat presses capable of consistent results at large scales, that are effective, but difficult to replicate on the small-scale.

It is important to understand that we are not looking for *industrial scale* precision, but rather understanding, through repeated testing, how to recreate, imitate or improve these results on open spaces like FabLabs or Makerspaces.

Laser sealing

For this process, the starting point is a vector file to cut on the laser machine. The shape to be produced is a basic balloon, then we can move on to more complex geometries.

The basic principle is to have 2 or 3 passes for the materials to *weld,* with a small offset from the cutting vector. For these experiments, the offset was different in order to get the most accurate and best bond. To figure out which parameters are to be used on every offset, 5 different tries were made. Here are the results of every test.

- Offset: .1mm ☆★★★★
  - The lines were too close and the material didn't have enough time to cool down, so it produced some holes.
- Offset: .2mm ☆☆★★★
  - The lines were still too close, and the same issue happened.
- Offset: .3mm ☆☆☆☆★
  - This distance had much better results as it had enough time and area to cool down.
- Offset: .4mm ☆☆☆☆☆
  - This is the optimal distance between the offsets, produced the most consistent results.
- Offset: .5mm ☆☆☆☆☆
  - This one also had great results.

Three to four contours, at .4mm and .5mm produced the greatest results, while being consistent and easy to get.

Testing materials.

After designing the most optimal arrangement of vectors, it is time to use the laser cutter to seal the different materials. Below are the results.

LDPE ★★☆☆☆

Machine: Laser Cutter
Material: LDPE Plastic Film

Chip's bag ☆☆☆☆☆

Machine: Laser Cutter

Did it work?: **Yes**
Layer configuration: 2 layers
SEALING
Power: 30%
Speed: 200 mm/min
Offsets: 3
Fill: No
CUTTING
Power: 40%
Speed: 100 mm/min
Offsets: 1
Fill: No

Ziploc bag ★★★☆☆

Machine: Laser Cutter
Material: Polyethylene film
Did it work?: **Yes**
Layer configuration: 2 layers
SEALING
Power: 20%
Speed: 200 mm/min
Offsets: 3
Fill: No
CUTTING
Power: 35%
Speed: 100 mm/min
Offsets: 1
Fill: No

Mylar ☆☆☆☆☆

Machine: Laser Cutter
Material: Mylar
Did it work?: **NO**
Layer configuration: 2 layers
SEALING
Power: 22%
Speed: 1000 mm/min
Offsets: 3
Fill: No
CUTTING

Material: Polypropilene + aluminium film + Polyethylene
Did it work?: **No**
Layer configuration: 2 layers
SEALING
Power: 40%
Speed: 150 mm/min
Offsets: 3
Fill: No
CUTTING
Power: 60%
Speed: 100 mm/min
Offsets: 1
Fill: No

RipStop ☆☆☆☆☆

Machine: Laser Cutter
Material: RipStop
Did it work?: **NO**
Layer configuration: 2 layers
SEALING
Power: 65%
Speed: 100 mm/min
Offsets: 3
Fill: No
CUTTING
Power: 75%
Speed: 50 mm/min
Offsets: 1
Fill: No

Polyester film ★★★☆☆

Machine: Laser Cutter
Material: Polyester film
Did it work?: **Yes**
Layer configuration: 2 layers
SEALING
Power: 25%
Speed: 250 mm/min
Offsets: 3

Power: 60%
Speed: 400 mm/min
Offsets: 1
Fill: No

Fill: No

CUTTING

Power: 30%
Speed: 100 mm/min
Offsets: 1
Fill: No

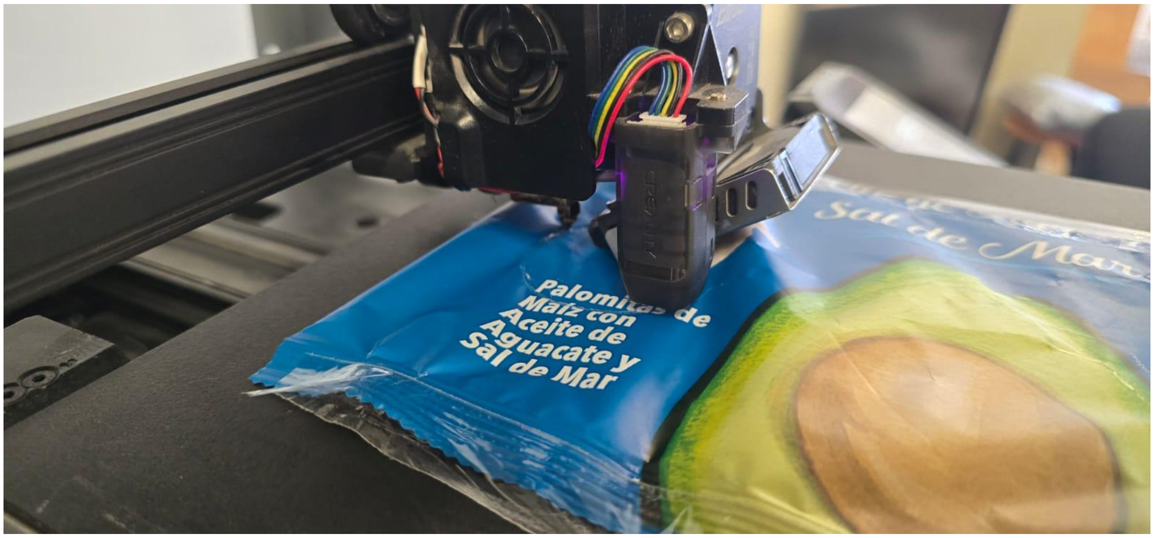
3D printer sealing

The principle of this process is to have the 3D printer nozzle, while hot, to complete passes on the materials for them to bond. The general parameters for this experiment were the same, but the ones that vary for different results are the temperature, speed, passes (in this case, walls), and layer height.

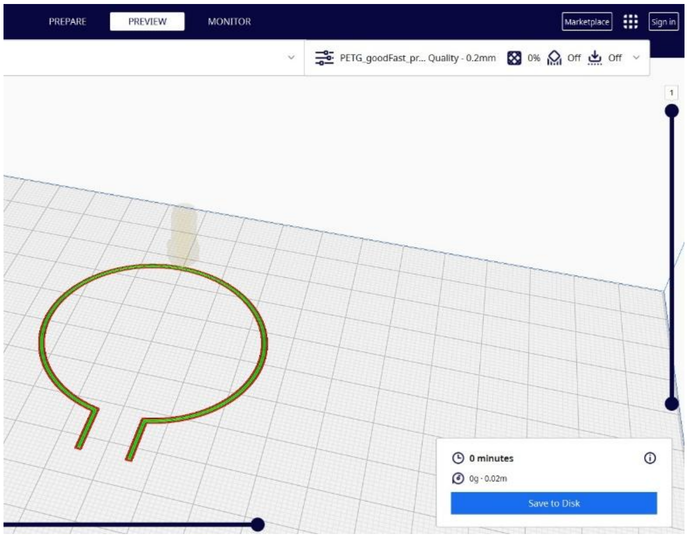
General Parameters

- **0 bottom layers –** This parameter works by *emptying* the area of the first layers.
- **0 top layers –** This parameter helps to keep the inner area/volume empty.
- **No buildplate adhesion –** The pattern is removed so only the walls are printed on the first layers.
- **0% Infill –** The infill pattern is emptied so nothing prints inside of the walls.

These changes in parameters ensure that the extruder will only pass over the parts/areas/vectors we want to weld.



The part that is designed is the same basic balloon as the previous tests, but in this case, it is not exported as a vector file, but as a *.stl* 3D model. Same vector but extruded .2mm.



PETG_goodFast_pr... Quality - 0.2mm 0% Off Off

0 minutes

0g - 0.02m

The preparation for the machine took a bit of *hacking*, as we are *decieving* the machine into thinking we are extruding material on the buildplate.
On the Ender 3 S1 Pro we just jammed the filament sensor with a bit of filament but removed the rest from the hot end.

For the Prusa, it is possible to print without any filament. The filament must be removed, then the machine will let you know there is no material to be found, and if you'd like to turn the sensor off, one must agree and carry on with the "printing".

Results

Enlisted below are the results of the hot-end sealing.

Textile vinyl ☆☆☆☆☆

- Machine: 3D printer
- Material: Textile vinyl
- Did it work?: **NO**
- Layer configuration: 2 layers

SEALING

- Hot end temperature: 150°-210°C
- Travel speed: 60 mm/min
- Z-offset (1st layer height): 0.1mm
- Number of passes: 1
- Wall number: 3
- Line width: .4mm
- Cooling fan: On
- Bed temperature: 65°C

Satin PVC ☆☆☆☆☆

- Machine: 3D printer
- Material: Satin PVC
- Did it work?: **NO**
- Layer configuration: 2 layers

SEALING

- Hot end temperature: 150°-210°C
- Travel speed: 60 mm/min
- Z-offset (1st layer height): 0.1mm
- Number of passes: 1
- Wall number: 3
- Line width: .4mm
- Cooling fan: On
- Bed temperature: 65°C

LDPE ☆☆☆☆☆

- Machine: 3D printer
- Material: LDPE
- Did it work?: **NO**
- Layer configuration: 2 layers

SEALING

- Hot end temperature: 150°-210°C
- Travel speed: 60 mm/min
- Z-offset (1st layer height): 0.1mm
- Number of passes: 1
- Wall number: 3
- Line width: .4mm
- Cooling fan: On
- Bed temperature: 65°C

Crystal PVC ☆☆☆☆☆

- Machine: 3D printer
- Material: Crystal PVC
- Did it work?: **NO**
- Layer configuration: 2 layers

SEALING

- Hot end temperature: 150°-210°C
- Travel speed: 60 mm/min
- Z-offset (1st layer height): 0.1mm
- Number of passes: 1
- Wall number: 3
- Line width: .4mm
- Cooling fan: On
- Bed temperature: 65°C

Polyester film ☆☆☆☆☆

- Machine: 3D printer
- Material: Polyester film
- Did it work?: **NO**
- Layer configuration: 2 layers

SEALING

- Hot end temperature: 150°-210°C
- Travel speed: 60 mm/min
- Z-offset (1st layer height): 0.1mm
- Number of passes: 1
- Wall number: 3
- Line width: .4mm
- Cooling fan: On
- Bed temperature: 65°C

Chip's bag ★★★★☆

- Machine: 3D printer
- Material: Polypropilene + aluminium film + Polyethylene
- Did it work?: **YES**
- Layer configuration: 2 layers

SEALING

- Hot end temperature: 150°-210°C
- Travel speed: 60 mm/min
- Z-offset (1st layer height): 0.1mm
- Number of passes: 1
- Wall number: 3
- Line width: .4mm
- Cooling fan: On
- Bed temperature: 65°C

Ziploc bag ☆☆☆☆☆

- Machine: 3D printer
- Material: Polyethylene film
- Did it work?: **NO**
- Layer configuration: 2 layers

SEALING

- Hot end temperature: 150°-210°C
- Travel speed: 60 mm/min
- Z-offset (1st layer height): 0.1mm
- Number of passes: 1
- Wall number: 3
- Line width: .4mm
- Cooling fan: On
- Bed temperature: 65°C

RipStop ☆☆☆☆☆

- Machine: 3D printer
- Material: RipStop
- Did it work?: **NO**
- Layer configuration: 2 layers

SEALING

- Hot end temperature: 150°-210°C
- Travel speed: 60 mm/min
- Z-offset (1st layer height): 0.1mm
- Number of passes: 1
- Wall number: 3
- Line width: .4mm
- Cooling fan: On
- Bed temperature: 65°C

Mylar ☆☆☆☆☆

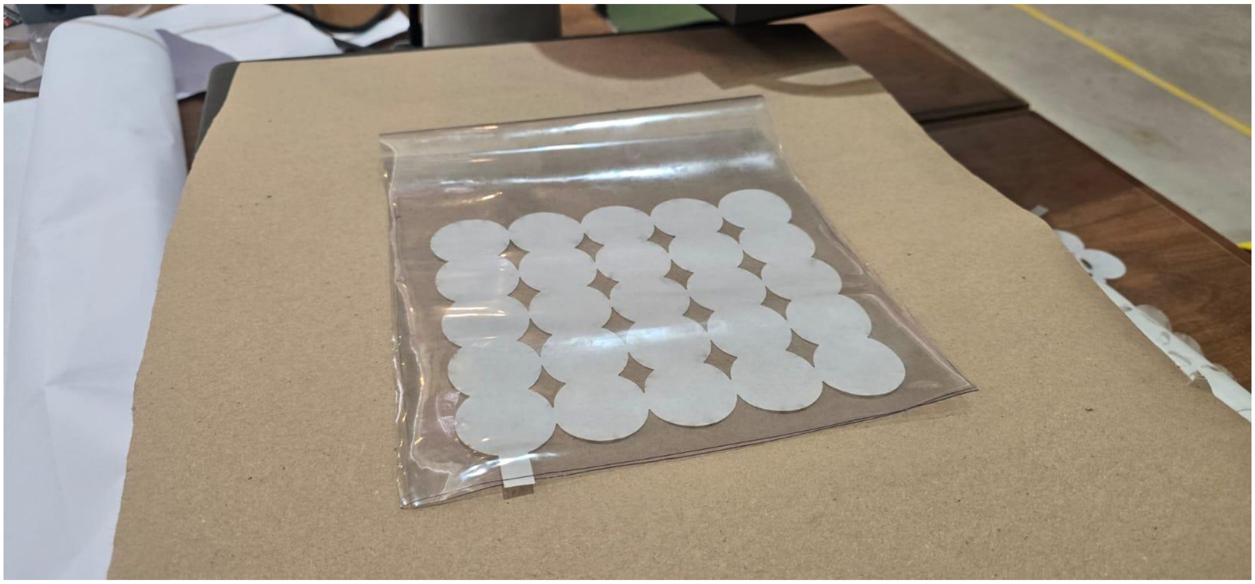
- Machine: 3D printer
- Material: Mylar
- Did it work?: **NO**
- Layer configuration: 2 layers

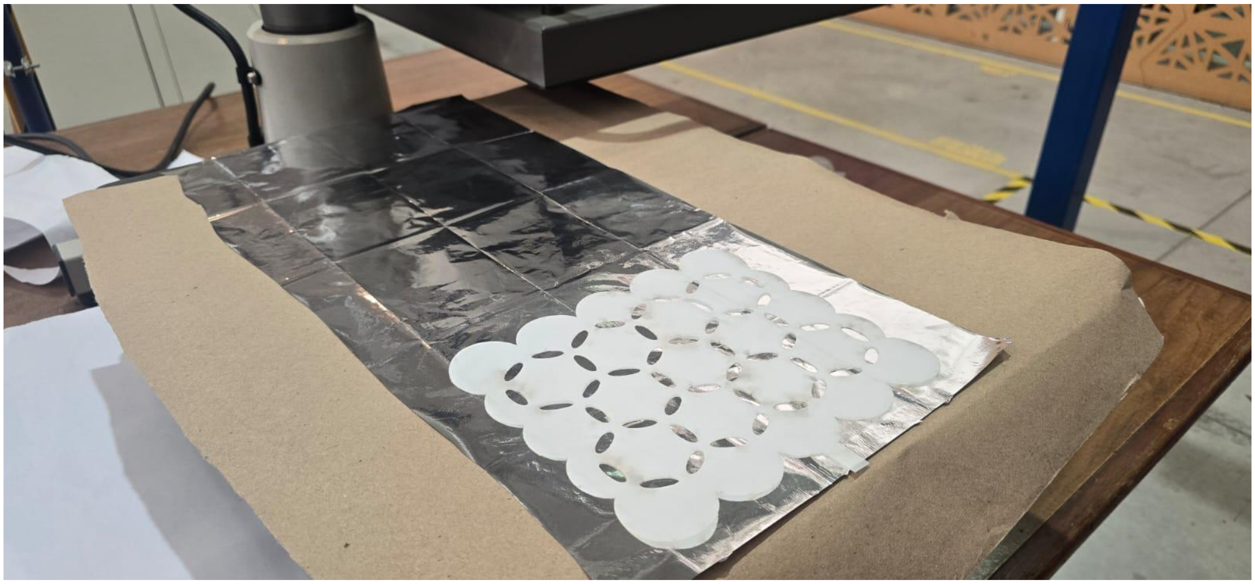
SEALING

- Hot end temperature: 150°-210°C
- Travel speed: 60 mm/min
- Z-offset (1st layer height): 0.1mm
- Number of passes: 1
- Wall number: 3
- Line width: .4mm
- Cooling fan: On
- Bed temperature: 65°C

Hot press + Parchment paper

Using the hot iron press for textile vinyl, we can fuse different layers of polymers. If we sandwich a sheet of, previously laser cut, kitchen waxed paper we can control which areas get fused and which ones get to inflate. On the bottom part, a tab was added for inflation.





Textile vinyl ★★★★★

- Machine: Hot iron press
- Material: Textile vinyl
- Did it work?: **YES**
- Layer configuration: 2 layers

SEALING

- Press temperature: 150°C
- Pressing time: 15s
- Observations: Brittle under pressure on sharp edges.

Polyester film ★★★★☆

- Machine: Hot iron press
- Material: Polyester
- Did it work?: **YES**
- Layer configuration: 2 layers

SEALING

- Press temperature: 150°C
- Pressing time: 5s
- Observations: Melts at high temperatures/times

Satin PVC ★★★★☆

- Machine: Hot iron press
- Material: Satin PVC
- Did it work?: **YES**
- Layer configuration: 2 layers

SEALING

- Press temperature: 200°C
- Pressing time: 15s
- Observations: Gets really soft with high temperature

Chip's bag ★☆☆☆☆

- Machine: Hot iron press
- Material: Chip's bag
- Did it work?: **NO**
- Layer configuration: 2 layers

SEALING

- Press temperature: 200°C
- Pressing time: 10s
- Observations: Doesn't stick to itself

RipStop ★★★☆☆

Crystal PVC ★★★★☆

- Machine: Hot iron press
- Material: Crystal PVC
- Did it work?: **YES**
- Layer configuration: 2 layers

SEALING

- Press temperature: 200°C
- Pressing time: 20s
- Observations: Special care

Polyester film ★★★★☆

- Machine: Hot iron press
- Material: Polyester
- Did it work?: **YES**
- Layer configuration: 2 layers

SEALING

- Press temperature: 150°C
- Pressing time: 5s
- Observations: Melts at high temperatures/times

LDPE ★★★★☆

- Machine: Hot iron press
- Material: LDPE
- Did it work?: **YES**
- Layer configuration: 2 layers

SEALING

- Press temperature: 100°C
- Pressing time: 60 mm/min
- Observations: Weak material, doesn't hold the pressure long.

Ziploc bag ★★☆☆☆

- Machine: Hot iron press
- Material: Ziplock bag
- Did it work?: **YES**
- Layer configuration: 2 layers

SEALING

- Press temperature: 150°C
- Pressing time: 10s
- Observations: Hard to unstick from the press

Mylar ☆☆☆☆☆

- Machine: Hot iron press
- Material: RipStop
- Did it work?: **YES**
- Layer configuration: 2 layers

SEALING

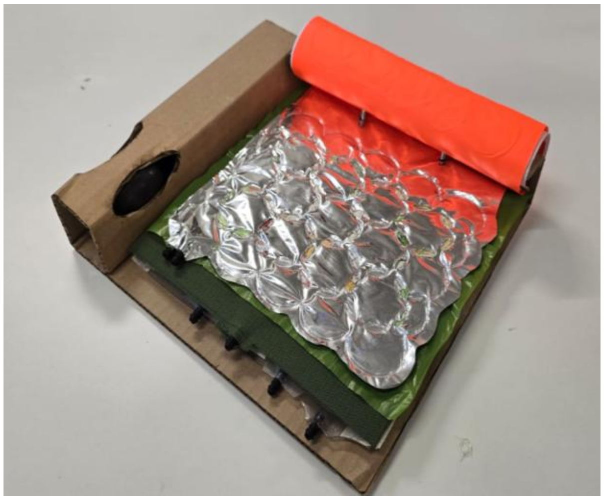
- Press temperature: 200°C
- Pressing time: 20s-25s
- Observations: Weak bonds

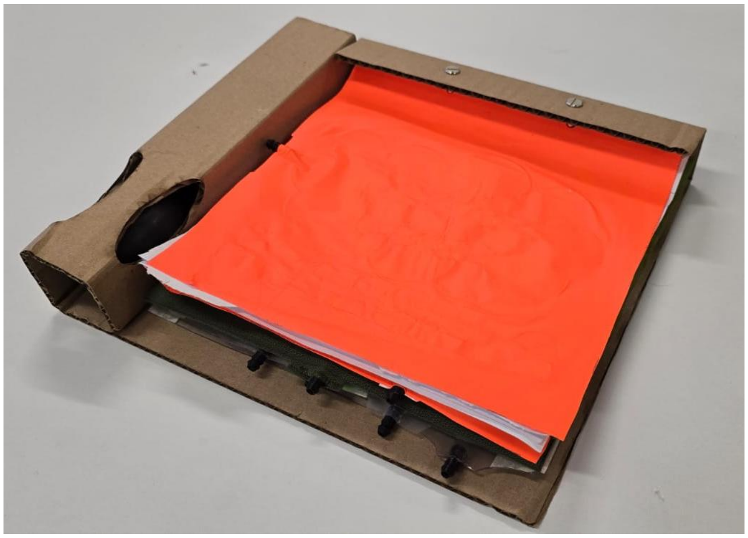
- Machine: Hot iron press
- Material: Mylar
- Did it work?: **NO**
- Layer configuration: 2 layers

SEALING

- Press temperature: 200°C
- Pressing time: 20s
- Observations: Doesn't stick to itself.

Gallery





Conclusions

Working with inflatable textiles was far more iterative and demanding than initially expected, as small variations in temperature, speed, time, geometry, or material could completely alter the outcome of a test. What appeared simple in concepts or sketches became unpredictable once translated into physical objects.

The biggest part of the project was repetitive testing, adjusting the parameters, tons of failures, calibration of tools and materials, which was technically very demanding, slow and frustrating, but at the end the most valuable aspect of the research. Every unsuccessful prototype gave light to the process that could not have been obtained through theory alone.

The experimentation part showed the importance of characterizing the parameters instead of assuming “it will probably work”: a mix between how the materials respond to heat, self-adhesion, pressure of the trapped air, and repeated inflation, and how the machines could repeatedly provide the same results.

As a closing argument, I would say that inflatable textiles are not static objects, but dynamic systems shaped by the material properties, the fabrication methods, and the geometries involved. One must “design for air”, considering pressure, expansion, movement, stress, adhesion, and geometry, all at once.

Design Rules

The protypes, observations, and failures contributed to a greater understanding of how to properly design inflatable textiles. Below you can find a collection of insights from my personal process.

Avoid Sharp Angles

Sharp corners accumulate internal pressure, which creates stress concentration points that weaken the seals between the layers. Rounded geometries distribute the pressure more evenly, producing better behaviors.

Maintain Consistent Airflow Paths

Air should have enough space to travel between the “chambers”, for example narrow channels restrict this airflow, which causes uneven inflation, isolated pressure zones, or even ruptures. Consistent width of the pathways improves the inflation speed and structural balance.

Design with Material Expansion in Mind

Inflatable structures do not behave as how they appear flat, each material expand differently depending on thickness, elasticity, self-adhesion, and pattern design. One most consider the volumetric expansion from the design to prevent deformation, and improve repeatability and predictability.

Keep Seals Wider Than Expected

Thin sealing areas may appear functional but most of the times they fail after repeated inflation. The wider the seal, the better, for it improves durability, and reduces the risk of air leakage.

Simplify Early Prototypes

Less is more (most of the time). Having this in mind, complex geometries often make it difficult to diagnose fabrication errors. Simplifying the design allows parameters to be calibrated effectively, before moving to more complex geometry.

Prototype at Small Scale Before Scaling Up

Start small, and eventually grow to bigger systems, as behavior changes with size. Small-scale prototypes help testing geometries, sealing methods, airflow, etc. While reducing material waste and fabrication time.

Future work

This project was intended, from the beginning, to create a starting point for exploration, somewhat like a framework that could help make inflatable textiles more approachable. That's why the **Open-source** aspect of it is so important.
One of the goals of this future work is to expand the collective knowledge of inflatable textiles, particularly within distributed labs and networks, like the FabLabs for example.

Garments

First, we understand materials, processes and workflows, the next step is to integrate them into wearable applications.
Not just decorative additions, but explore how the garments can actively influence the functionality, adaptability, physical behavior, dynamism, insulation, interaction, etc.
The transition between fabricating samples, to wearable prototypes represents an important step in the project.

Website/Community/Platform

The overall direction of this project is aimed into expanding the accesibility of this information, democratizing it even, through open digital platforms and collaborative online communities.
Firstall this documentation could be shared through existing online platforms for communities focused on makers, FabLabs, digital fabrication, etc. Such as **Reddit** and other open forums.
Over time, the project could evolve into a dedicated platform where users upload experiments, characterizations, materials, questions, comparisons, and workflows altogether. Inspired by platforms like **Materiom.org** the intention is to create a growing repository of accessible and open knowledge, all community driven.

Because knowledge only matters when it can be shared.

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