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Study of individual freedom in the century of automation: proposition of the control curves model in digital surveillance environments

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Sandro Christovam Bearare1

Summary

The rapid advance of automation, digital surveillance and algorithmic control has brought about profound changes in the way individual freedom is perceived, exercised and limited. The constant presence of intelligent systems in everyday decisions, combined with the standardization of behaviors encouraged by technological structures, raises urgent questions about the real space of autonomy available to ordinary citizens.
This article proposes the conceptual construction of "Control Curves": a theoretical model that seeks to represent the inverse relationship between the growth of automated mechanisms of social regulation and the progressive reduction of practical freedom. By identifying critical variables and inflection zones, the study aims to offer an analytical tool capable of anticipating stages of loss of autonomy in highly controlled environments. More than a critique of technology, it is an effort to understand how to preserve freedom in a century where control is not imposed by force, but by the silent programming of choices.

Keywords: individual freedom; automation; digital surveillance; social control; algorithmic decision; control curves.

Abstract

The rapid advancement of automation, digital surveillance, and algorithmic control has deeply transformed how individual freedom is perceived, exercised, and restricted. The constant presence of intelligent systems in everyday decision-making, combined with the behavioral standardization encouraged by technological structures, raises urgent questions about the current space left for personal autonomy. This article introduces the conceptual model of "Control Curves": a theoretical framework designed to represent the inverse relationship between the expansion of automated mechanisms for social regulation and the progressive reduction of practical freedom. By identifying critical variables and inflection zones, the study aims to provide a tool for analyzing and anticipating stages of autonomy loss in highly monitored environments. More than a critique of technology, it is an attempt to understand how freedom can be preserved in a century where control is no longer imposed by force, but by the silent programming of choices.

Keywords: individual freedom; automation; digital surveillance; social control; algorithmic decision-making; control curves.

[1] Electrical Engineer, MBA in Production Engineering, postgraduate degree in Logistics, psychopedagogy and extension in neuroscience. Specialist in security, in the education and training of professionals in the area of weapons and shooting, with extensive experience in project development, logistics processes and team coordination, security consultant and speaker. E-mail: scbearare@bol.com.br

1. Introduction

Individual freedom has always been considered one of the fundamental pillars of civilized coexistence. In different historical contexts, it has represented the right to choose, act, disagree and resist. However, in contemporary society, marked by the continuous advance of automation and digital surveillance, this concept has been undergoing silent and profound transformations. What was once limited by laws or visible forces is now restricted by invisible codes, opaque algorithms and technological structures that operate constantly and almost imperceptibly.

The increasing presence of automated systems in routine activities — from urban traffic control to digital content filtering — has changed not only human behavior, but also the very perception of what it means to be free. Choices are directed, decisions are anticipated, and actions are monitored in real time. In this scenario, individual autonomy does not disappear explicitly, but is diluted in a continuous flow of subtle and preconfigured conditioning.

This article is based on the hypothesis that freedom, in the context of advanced automation, can be analyzed through a theoretical model based on behavior curves. The article proposes the construction of "Control Curves", which seek to represent the inverse relationship between the level of automation and the real margin of freedom available to the individual. The central idea is to understand to what extent the expansion of control mechanisms — especially digital and automated ones — compromises the practical capacity for choice and reaction, even when formal rights remain guaranteed.

The rationale for this study is the need to develop new analytical tools that help identify, measure, and anticipate the effects of digital control on human autonomy. Instead of treating freedom as an abstract or merely legal concept, this work proposes a more functional and structured approach, capable of generating indicators, comparisons, and hypotheses applicable to different social contexts. In the end, it is expected that the model presented can serve as a basis for future research on security, behavior, and rights in times of increasing automation.

2. Individual freedom: concept, value and challenges

Individual freedom, although often cited as a universal principle, is a concept that has taken on different forms and interpretations throughout history. In the legal field, it is linked to the absence of arbitrary restrictions and the right to lead one's own life according to personal choices. In philosophy, it is seen as an essential condition of human dignity, related to moral autonomy, conscience and responsibility. In practical terms, freedom translates into the ability to act, decide, react and, above all, not be prevented from exercising these capacities without legitimate justification.

Despite its centrality in Western thought, freedom has never been absolute. In any organized society, it coexists with norms, limits and collective responsibilities.
The central question, therefore, is not the existence of limits, but the way in which these limits are

established, applied and perceived. When limits are clear, fair and transparent, freedom adapts and reorganizes itself. But when they emerge in an opaque, automated way or camouflaged under the discourse of collective well-being, the risk of erosion of individual autonomy becomes real.

In current times, this erosion does not occur explicitly, but rather through technological and institutional mechanisms that redesign the space for human action without necessarily having a formal prohibition. A clear example is the use of predictive systems and filtering algorithms, which determine what is seen, what is consumed and even what is considered acceptable within a given social network or digital environment. Choice continues to exist, but within an invisible framework, previously structured by codes and interests.

Another challenge lies in the naturalization of this process. As automation systems become part of everyday life, the perception of freedom becomes accommodated within the parameters established by these tools. Freedom ceases to be an active exercise and becomes a set of pre-formatted responses. The individual continues to believe that he or she is making a choice, but in practice, he or she is merely navigating between limited and supervised options.

This chapter seeks to reinforce the idea that individual freedom, beyond an abstract right, must be understood as a dynamic field, constantly pressured by external forces. Understanding its structure, its weaknesses and the factors that limit it is essential for any serious proposal to protect human autonomy in the face of advances in digital control and automation.

2. Automation and control: recent developments

In recent decades, the relationship between technology and social control has undergone a significant shift. What once depended on the direct action of institutions and authorities now operates through automated systems, predictive algorithms, and integrated digital surveillance structures. This new configuration of power no longer requires the constant presence of human agents to monitor, direct, or restrict behavior. Control has become part of the environment, embedded in the devices, networks, operating systems, and platforms used daily.

Automation, in and of itself, is not a problem. It was created to increase efficiency, reduce errors, and facilitate repetitive tasks. However, when applied to decisions that directly affect individual freedom—such as what can or cannot be said, done, shown, or accessed—it begins to interfere in spheres previously reserved for human consciousness and individual judgment. The result is an invisible but functional control architecture that shapes choices without the need for explicit imposition.

A clear example is social media. Platforms that present themselves as free spaces for expression use algorithms that filter, prioritize or hide content based on technical and commercial criteria. The user still has the feeling of freedom, but their experience is built by systems that determine what they will see and what will be suppressed, without transparency or possibility of dialogue. This logic extends to other sectors, such as

public safety, advertising, urban mobility, credit, access to services and even personal relationships.

Another critical point is the replacement of human judgment by automated decisions in sensitive sectors. In many contexts, algorithms are taking over functions previously assigned to qualified professionals, such as risk analysis, behavior recommendations, and person classification. The problem lies not only in the technology, but in the lack of clear ethical criteria, the absence of adequate oversight, and the tendency to treat these systems as neutral or infallible.

With automation, social control has become faster, more efficient and harder to challenge. It does not appear as censorship, but as a filter; it does not act as repression, but as a recommendation; it does not impose directly, but conditions in an almost imperceptible way. This transformation requires a new type of attention: a critical vigilance over the surveillance tools themselves.

This chapter shows that to understand the loss of freedom in the 21st century, it is not enough to look at laws or institutions. It is necessary to observe how automated systems are silently taking over the role of organizers of human behavior — and what the consequences of this are for individual autonomy.

3. The proposal of Control Curves

The observation of the cumulative effects of automation, surveillance and standardization of behavior suggests the need for a new way of analyzing the real impact of these elements on individual freedom. Although there are studies on censorship, institutional oppression and legal restrictions, there are still few attempts to represent, in a structured way, the gradual process of loss of autonomy in the face of the advance of technological control. It is in this context that the proposal of Control Curves arises.

4.1 Basic concept

Control Curves are a theoretical model created to represent the inverse relationship between the level of automation and the practical freedom available to the individual. The greater the presence of automated mechanisms of social regulation — such as surveillance systems, algorithmic filters and data-driven decisions — the smaller the real space for autonomous decision-making tends to be. The curve illustrates this movement progressively, allowing us to visualize distinct stages of control and their respective effects on human behavior.

4.2 Main variables

To build the model, three fundamental variables are considered:

- **Level of automation (A):** degree of interference of automated systems in the routine individual;
- **Degree of surveillance (V):** intensity of monitoring to which the individual is exposed, including physical, digital and behavioral surveillance;
- **Margin of practical freedom (L):** real space available for choices, actions and reactions without direct external interference.

The relationship between these variables can be described qualitatively as:

The larger A and V, the smaller L tends to be.

Although this formula does not represent a precise mathematical equation, it serves as a basis for modeling behaviors in high-control contexts.

4.3 Curve types

Depending on the environment analyzed, it is possible to view different curve patterns:

- **Direct control curve:** environments with explicit surveillance and rigid rules. Freedom falls abruptly as control increases.
- **Gradual control curve:** environments with increasing automation and invisible filters. Freedom is being reduced almost imperceptibly.
- **Inverted control curve:** scenarios where the individual believes he is freer, but in fact he is being more monitored and conditioned.

These patterns allow us to compare different contexts — such as social networks, schools, smart condominiums, corporate environments, or even countries — and assess the degree of real interference in individuals' behavior.

4.4 Inflection points and critical zones

The curves also help identify **inflection points,** that is, moments when freedom suffers more abrupt declines, generally after the introduction of new technologies, restrictive legislation or significant cultural changes. In addition, it is possible to identify **critical zones,** in which the perception of freedom remains high, even when control is already consolidated. In these zones, resistance is minimal, which makes control even more effective.

The Control Curve model is not intended to provide an exact mathematical representation, but rather a conceptual tool for understanding how freedom is being redesigned in the age of automation. By visualizing this process in curves, it is possible to develop comparative studies, simulate future scenarios and propose strategies for preserving autonomy in contexts where interference is constant but rarely visible.

4. Possible applications of the model

The proposal of Control Curves is not limited to theory. Its main strength lies in the possibility of practical application in different contexts, helping researchers, managers, educators and security professionals to understand how freedom is being shaped — or restricted — in increasingly monitored and automated environments.

4.1 Assessment of everyday environments

The model can be used to analyze spaces such as:

- **Smart condominiums:** with facial recognition, motion sensors, automation of access and internal rules monitored in real time;
- **School environments:** where students are tracked by digital presence systems, educational software with behavior metrics and content filters;
- **Social networks:** with algorithms that shape what can be seen, said or promoted, based on patterns defined by corporate interests or automated criteria;
- **Corporate environments and public institutions:** with productivity monitoring, access control, internal surveillance systems and online behavior analysis.

In each of these environments, it is possible to identify the dominant curve pattern (direct, gradual or inverted) and assess the extent to which control interferes with the practical autonomy of individuals.

4.2 Comparisons between social and temporal contexts

Control Curves also allow comparisons to be made between:

- **Countries and cultures:** analyzing how different societies deal with the relationship between security, technology and freedom;
- **Decades or historical milestones:** visualizing how certain laws, events or innovations caused declines in individual freedom;

• **Institutional models:** such as public vs. private schools, or traditional companies vs. startups, and their different levels of internal control.

This comparative capacity is useful for identifying trends, anticipating risks and proposing course corrections.

4.3 Simulation of future scenarios

The model can be adapted to simulate future scenarios based on the predicted advancement of certain technologies, such as:

- Fully smart and interconnected cities;
- Work environments with supervisory AI and behavioral biometrics;
- Social platforms with 100% automated moderation;
- Public systems based on social scoring, as already occurs in some countries.

By predicting how freedom tends to behave in these scenarios, it becomes possible to plan mitigation measures, propose more balanced regulatory frameworks and reinforce the importance of autonomy as a technical and ethical criterion in the development of new systems.

4.4 Support for research and education

Control Curves can also be applied to research projects, academic disciplines and courses focused on ethics, security, technology and human rights. Visualizing the impact of automation on freedom can help students and researchers to understand more clearly the risks of behavioral neutralization through intelligent systems.

More than a metaphor, the model presents itself as a practical tool for mapping the silent process of forced adaptation of human behavior in controlled environments. By making it visible, it is possible to reestablish the debate about limits, responsibility and, most importantly, about what it means to be free in an era of automated decisions.

5. Limitations and suggestions for future research

Like any theoretical model, the Control Curves proposal has limitations that need to be acknowledged. Its goal is not to provide a precise mathematical representation of freedom, but rather to offer a conceptual framework capable of assisting in the analysis of the impact of automation and surveillance on individual autonomy. Although useful for reflection and initial comparisons, the model requires improvements for use in quantitative studies and more detailed empirical evaluations.

6.1 Subjectivity of freedom

One of the main limitations is the subjective nature of the concept of freedom. What is perceived as excessive control by one person may be considered an acceptable security measure by another. This variability makes it difficult to construct standardized metrics and requires care in interpreting the data. The proposed curves seek to represent general trends, but they do not replace specific contextual analyses.

6.2 Need for empirical validation

The model still lacks empirical validation through case studies, interviews, direct observations and cross-referencing with concrete social indicators. The practical application of the curves in real environments requires the development of instruments that allow measuring the levels of automation, surveillance and perceived freedom based on objective and replicable criteria.

6.3 Dynamism of the contexts analyzed

Another challenge lies in the dynamic nature of modern environments. Technologies, legislation and social behaviors change rapidly, which makes it difficult to apply a fixed or static model. Control curves need to be adaptable to these changes, remaining a tool for continuous reading, rather than a closed structure.

6.4 Suggestions for further study

To make the model more robust, it is recommended:

- Develop case studies in specific environments (schools, social networks, public institutions);
- Conduct qualitative research on the perception of freedom in environments automated;
- Build indicators that combine technical variables (number of cameras, active systems) with psychological variables (feeling of surveillance, self-censorship);
- Explore possibilities of integrating the model with other theoretical approaches, such as the notions of panopticism, biopower, algorithmic governmentality and the psychology of social control.

The Control Curves model should be understood as a starting point. Its value lies in opening space for new ways of thinking about the impact of technology on autonomy. By generating questions, provoking comparisons and proposing new visualizations, it invites academia to take a more critical and structured look at a question that, although old, gains new dimensions with each technical advance: to what extent are we free to decide — and what prevents us from realizing when this freedom begins to disappear.

6. Final considerations

Freedom, understood as the real capacity to decide, act and react, is being redesigned by processes that operate constantly, silently and increasingly automated.
Unlike historical periods marked by direct censorship or open repression, contemporary control manifests itself through algorithms, interfaces, sensors and structures that shape behavior without the need for explicit imposition.

In this article, the concept of Control Curves was proposed as a theoretical tool to analyze this phenomenon. Based on the relationship between automation, surveillance and autonomy, the model seeks to represent how individual freedom can be gradually reduced, without necessarily causing a clear legal or institutional violation. The aim is not to replace other approaches to the subject, but to add a new perspective to the discussion, especially useful in contexts where control is no longer perceived as oppressive, but as part of the "normal" functioning of everyday life.

Although the model still requires empirical validation and methodological adjustments, it offers a promising basis for researchers who wish to investigate the effects of technology on human autonomy in a structured and comparative way. In times of increasing automation of decisions and constant monitoring, understanding how freedom is conditioned becomes an urgent need.

The proposal presented here invites active reflection: if freedom is not being taken away by force, but rather programmed little by little, how will we know when it is over? And more importantly: what can we do before the margin of choice disappears without anyone noticing?

References

BAUMAN, Zygmunt. *Liquid Surveillance.* Rio de Janeiro: Zahar, 2013.

FOUCAULT, Michel. *Discipline and Punish: The Birth of the Prison.* Petrópolis: Vozes, 2014.

GEORGE, Orwell. *1984.* New York: Routledge, 2009.

LYON, David. *The surveillance society: monitoring, surveillance and power in everyday life.* São Paulo: Loyola, 2007.

ZUBOFF, Shoshana. *The Age of Surveillance Capitalism.* Rio de Janeiro: Intrínseca, 2021.

MOROZOV, Evgeny. *Big Tech: the rise of data and the death of politics.* São Paulo: Ubu, 2022.

BRAZIL. *Constitution of the Federative Republic of Brazil of 1988.* Brasília: Federal Senate, 2016.