# 3. A Specter, a Deity and a Flood in the Black Box of Finance, or the Possible in the Actual

The whole terrible fight occurred in the area of imagination. That is the precise location of our battlefield. It is there that we experience our victories and our defeats.

— Haruki Murakami, After the Quake

## Introduction[[1]](#footnote-1)

Remember the trading floor of the New York and other major Stock Exchanges of the 1990s? Today, the stock exchanges look little like the days of yore. Gone is the noise and smell coming from rowdy men dressed in suits with the occasional color-coded overcoats, milling around stock booths, tensely looking at screens with graphs and numbers on them, while shouting into telephones, gesticulating and making hand signs. Robots took their jobs. Or rather, today, an estimated 75% of the buying and selling of stock is done by high-frequency trading (HFT) algorithms that automatically issue orders, in milliseconds, and respond to one another and to shifting market conditions.[[2]](#footnote-2) These developments, combined with the rise of trades in rather complex financial instruments and the global financial crisis that started in 2008, strengthened the image of the financial markets as unpredictable and turbulent.[[3]](#footnote-3)

The Flash Crash of May 2010 showed what possible effects this unpredictability and turbulence could have. On Thursday, May 6, 2010, at 3.42 PM, something extraordinary happened on the New York Stock Exchange. The stock market index tracker of the United States, the Dow Jones Industrial Average, which comprises 30 of the biggest U.S. corporations and is regarded as representative of the performance of U.S. financial markets, made the deepest plunge in its 114-year-old existence. In a few minutes, the Index dropped nearly a thousand points and $700 billion evaporated. Shortly after the market bounced back, Lazarus-like, and after 36 minutes, prices returned to normal, as if nothing had happened. On May 6, 2010, the Flash Crash, as this event had been coined, became world news and became a concept.

There are different explanations as to what caused the Flash Crash. Some claim it was due to glitches.[[4]](#footnote-4) It has also been suggested that a system-wide failure occurred when certain HFT algorithms interacted in unexpected and frantic ways.[[5]](#footnote-5) Others blame a little-known rogue trader, operating with the firm name Milking Markets from his parents’ house in the suburbs of London, who allegedly used an illegal algorithmic trading strategy — spoofing — that created what is called ‘order unbalance’ on the markets.[[6]](#footnote-6) An independent committee of American regulators, the SEC, in collaboration with the Commodity Futures Trading Commission (CFTC), published a report, the result of their joint investigation into the causes of the Crash, that warned of serious future harm and mischief caused by algorithmic trading when not monitored, regulated, and scrutinized with parameters and procedures.[[7]](#footnote-7) Their report further emphasizes ‘the importance of data in today’s world of fully-automated trading strategies and systems’.[[8]](#footnote-8) The SEC wrote that it would work closely with market centers ‘to help ensure the integrity and reliability of data processing’.[[9]](#footnote-9) The report states that the behavior or a specific sell algorithm from a ‘large fundamental trader’, later identified as American asset management company Waddell & Reed, was a major cause in the chain of events of May 6, 2010.[[10]](#footnote-10) Another report, published by Nanex, a U.S. based financial market data analyst company disputes this view.⁠[[11]](#footnote-11) Nanex states that without access to the data accounts of specific traders and brokers, to which neither Nanex nor the SEC has access, no final answer as to what the leading causes of the crash can be given. Since 2010, at least five such Flash Crashes have occurred. In addition, according to a report of a group of researchers from the University of Florida from 2011, nearly 19,000 mini flash crashes took place between 2006 and 2011.

There seems to be a correlation between a series of events in the financial markets and the growing number of contemporary artists critically engaging with algorithmic trading. These events start in 2008 and include the Flash Crash of 2010, and worldwide stock market plunges, interbank market freezing, nationalization of international banks by national governments, the bankruptcy of Lehman Brothers, the near-collapse and bailout of the American International Group, and a subprime mortgage crisis followed by foreclosures. As these events unfolded in the context of a global recession, the notion of financial markets as a cybernetic, self-correcting, and mathematical machine eroded. As the recession placed the biggest burden on people with lower incomes and didn’t leave middle-income earners unscathed, many people lost their sense of security and trust in banks, the housing market, retirement funds, job security, and in governments’ abilities to manage the financial markets. With the aid of bailouts and backstops by governments, quantitative easing by central banks, and regressive risk transfer in the form of austerity programs, repressed wages, mortgage bearing, debt loading, precarious employment, and rising asset prices, the financial markets keep on keeping on. For some, however, cracks were exposed in the financial markets’ foundations. Once seen, these cracks could not be unseen. These events brought to view the ostensible blurry line between financial operators and governance, where the failure of a financial institution creates ripple effects and takes down wider financial structures, bringing to its knees not just ‘the financial markets’ but also the savings of many. This has played into major anxieties entwined around algorithmic high-frequency trading.

This chapter looks at how artist grapple with the algorithmic automation of the financial markets. More specifically, it looks at how artists imagine and represent algorithmic high-frequency trading on financial markets to trace the outlines of the major anxieties braided around algorithmic high-frequency trading and gestures towards ways around them. The chapter is divided into four sections. The first section, ‘Black Box Anxiety’, explains the concept and the common reference point of the ‘black box’ as it developed from a cybernetic concept to how it is used in present-day academic discourse in relation to the inner workings of and the dynamic between trading algorithms and social reality. The second section, ‘Imagining the Black Box of Finance: Digging Down and Standing Back’,sketches dominant modes of representation of trading algorithms by conducting a close reading of prominent artworks that have been exhibited in Europe, the Americas and China in renowned galleries, museums and art institutions. In this section, I distinguish between two predominant ways of representing algorithmic trading by building on what Rita Felski describes in *The Limits of Critique* (2015) as ‘digging down’ and ‘standing back’. The primary aim of digging down is to probe below the surface and to enter and penetrate meanings hidden from sight.[[12]](#footnote-12) Artists that ‘dig down’ visualize supposedly invisible aspects of algorithmic trading. This approach indicates that what largely remains out of sight and un-accessed forms a fundamental part of algorithmic trading.[[13]](#footnote-13)

Standing back, as a second popular approach, aims to demystify algorithmic trading. By demystifying it attempts to ‘denaturalise — to show there is nothing self-evident about its form or content. Whatever is the case is radically contingent and could be otherwise.’[[14]](#footnote-14) It is ‘weaned to Foucault’ and offers a view ‘of systems of discourse and grids of power’.[[15]](#footnote-15) The section ‘Re-Imagining the Black Box of Finance’ explores a relational view on algorithmic trading conveyed in the works of two artists: Emma Charles and Femke Herregraven. In their work algorithmic trading appears not as a substance but as a relation. Both artists conjure up invisible powers to which algorithmic trading stands in relation. Combined, their works can be considered as artistic reminders of what Kierkegaard had in mind with his conception of the possible. In the last section of this chapter, ‘Spectral Interventions in the Black Box of Finance’, describes what this spectral relation entails.

## Black Box Anxiety

One of the major anxieties braided around high-frequency trading has to do with a persistent idea, both in contemporary art and in academia, that suggests that algorithmic trading is like a black box whose operations are increasingly invisible, unimaginable and unmanageable, yet can have catastrophic effects. The concept originates from the discipline of cybernetics. Ross Ashby described black boxes in his *Introduction to Cybernetics*:

The child who tries to open a door has to manipulate the handle (the input) so as to produce the desired movement at the latch (the output), and he has to learn how to control the one by the other without being able to see the internal mechanism that links them.[[16]](#footnote-16)

According to this cybernetic view, all self-regulating systems are such a black box. They are systems in which the input (the stimulus) differs from the output (the response). A relationship between the two is assumed whereby the stimulus is adjusted on the basis of the response — a control system. Broadly understood, the concept of the black box refers to systems that involve a largely controllable input and a verifiable output, but the internal process that effects the transformation of input to output is opaque and mostly unknown — enclosed in a black box.

The concept has travelled. Within cybernetics, it was developed as a model to study systems whose internal mechanisms are not open to inspection. Later, in the nineties, the concept of the black box became a central term in science and technology studies, as it was changed into a verb by Bruno Latour to describe ‘[t]he way scientific and technical work is made invisible by its own success’.[[17]](#footnote-17) [[18]](#footnote-18) [[19]](#footnote-19) That is, when technology runs smoothly, its internal complexity is often no longer a matter of concern. ‘Thus, paradoxically, the more science and technology succeed, the more opaque and obscure they become’, Latour argued.[[20]](#footnote-20)

These days, publications such as Basil J. Moore’s *Unpacking the Post Keynesian Black Box* (2015), Frank Pasquale’s *The Black Box Society: The Secret Algorithms that Control Money and Information* (2012), and Donald McKenzie’s *Opening the Black Boxes of Global Finance* (2005) demonstrate that the black box is a customarily-referenced concept in theories of finance. In the context of trade on the financial markets, the black box symbolizes an obstacle to an understanding of and control of finance. The black box often evokes mystic metaphors to articulate obscure, opaque and incomprehensible market dynamics, both to artists and academics. In *Making Money: The Philosophy of Crisis Capitalism,* Ole Berg describes trading algorithms as ‘dirty’ philosophical objects that are ‘fundamentally unknowable’.[[21]](#footnote-21) Adrian Mackenzie claims trading algorithms as ‘characterised by unpredictable slippages’ that cannot be isolated as an object.[[22]](#footnote-22) Arne de Boever observes in *Finance Fictions: Realism and Psychosis in Time of Economic Crisis* that on today’s financial market algorithms trade at frequencies ‘too high for human beings or even computers to observe’.[[23]](#footnote-23) And in *The Black Box Society: The Secret Algorithms that Control Money and Information*, Frank Pasquale quotes Alan Greenspan to argue that today’s markets are ‘unredeemably opaque’ and ‘no one (including regulators) can ever get more than a glimpse at the internal workings of modern financial systems’.[[24]](#footnote-24)

Pasquale contends that the opacity of the black box is due to proprietary algorithms that analyze and process data and make critical decisions, yet remain inaccessible to outsiders and immune from scrutiny. The proprietary algorithms used in finance are based on complex and secret calculations and those models are in turn based on at times faulty, incomplete, or fraudulent data, with instability as a result.[[25]](#footnote-25) What makes the black box ‘black’, according to Pasquale, is ‘obfuscation in the service of illegality, and opacity resulting from complexity’.[[26]](#footnote-26) Understanding algorithms is limited by their black-box nature, Pasquale argues. He is concerned about algorithms that might ‘take on a life of their own’.[[27]](#footnote-27) Algorithmic trading, he warns, can cause extraordinary instability and frozen markets when algorithms interact in unexpected ways, which may result in ‘dangerous feedback loops’.[[28]](#footnote-28) The contemporary world, Pasquale argues, resembles a one-way mirror; public powers and corporate actors have unparalleled knowledge of our daily lives, while we know next to nothing about how this knowledge is used to influence our decisions.[[29]](#footnote-29)

Yuk Hui is also concerned about the possible havoc algorithms may wreck by virtue of their unknowability. In *Algorithmic Catastrophe: The Revenge of Contingency* (2015), Hui relates the black box to catastrophe. Algorithms, Hui argues, aim to overcome contingency but also generate contingency. He distinguishes between two forms of algorithmic contingency. The first, contingency as necessity, results from the internal dynamics of automation as a probability within itself and can be reasoned, determined and anticipated by thought — think of bugs, error reports, flaws in a model, miscalculations, 404s, and the like. The second, contingency as possibility, cannot be predicted, determined by reason, nor anticipated and happens outside the probable. The first type is generated and anticipated by the machine’s operations — a necessity from within. The second is generated by the machine’s own unanticipated and unknowable operations — a possibility from within or outside.[[30]](#footnote-30) Hui claims that with the increasing implementation of algorithmic automation we are witnessing the emergence of algorithmic catastrophe of the latter type, ‘the control of which is increasingly beyond the capacity of human beings’.[[31]](#footnote-31) Confronted with such unexpected events that we don’t even know we should know about, ‘the unknown and the black box become the sole explanations’.[[32]](#footnote-32)

The black box has become a metaphor for the unknown, the hidden, and for the conviction that what is unseen and unknown is more dangerous, powerful and profound than what is manifest and visible. In artistic portrayals of algorithmic trading, the black box is a common source of anxiety. The anxieties it evokes are often laid onto trading algorithms, specifically, and on the perceived invisibility of the infrastructural and technical components of algorithmic trading more generally.

## Imagining the Black Box of Finance: Digging Down and Standing Back

In the following section, I discuss two major artistic approaches to representing the black box of finance: digging down and standing back. The difficulties of imagining and expressing what is considered to be an abstract and immaterial market that appears to "happen" inside a black box, and out of sight of human inspection, is a recurring theme in digging down representations of algorithmic trading. The second approach, standing back, is characterized by artists that re-enact or mimic the inner workings of algorithmic trading. These works often foreground their political agenda and take an often performative, satirical approach. Both approaches tend to focus on and add emphasis to a limited set of infrastructural aspects of algorithmic trading.

## The Aesthetics of the Outside of the Black Box: Digging Down

There is a shared urge among artists to probe algorithmic high-frequency trading from the outside, focusing on the inputs and outputs. Similar to masking and camouflage strategies discussed in Chapter 2, this approach gives shape to representations of what is considered to be an intangible, invisible and immaterial infrastructure. Yet, different from masking and camouflage practices, which aim to recede into the background and become unrecognizable from the background, these artworks presuppose an artistic subject as a kind of field guide cum documentarist, present in space as a point of reference, and posit the black box of finance as an invisible object that, in turn, is made visible and materialized by virtue of the artist ‘s position as field guide cum documentarist.

Take, for instance, Mark Curran’s *The Market* (2010 - ongoing), an artistic research project that covers specific sites in Dublin, London, Frankfurt, Addis Abeba and Amsterdam. Curran:

I became aware of the central role of technology, specifically what we may define as algorithmic machinery… within a decade there will be no human traders, having been largely replaced by these systems. …And this is where it can become rather dystopian.[[33]](#footnote-33)

Visitors of an exhibition view of *The Market* are shown a quote written on a wall of the exhibition space and ascribed to an anonymous trader from London City. It is a snippet from a phone conversation the artists had with the trader in 2013: ‘What people don’t understand is that what happens in the market is pivotal to their lives […] not on the periphery […] but slap, bang, in the middle’. In his work, Curran turns to the institutional infrastructures of algorithmic high-frequency trading and the people working within them.[[34]](#footnote-34) *The Market* consists of photographs portraying the office buildings of financial institutions, housed at one of the five financial capitals; portrait photography of individuals working on the financial markets at said locations; transcripts of interviews conducted with traders and bankers working at these sites; research documents; and a soundscape.

The photographs form a central part of *The Market.* Their aesthetics mode might be described as documentary, given their somewhat ‘straight up’ style and their neutral, descriptive caption that reinforces a feeling of time and space. Exemplary is his photograph of a trader in The City. A young white man in a suit looks directly and deliberately at the camera, while he stands in front of corporate architecture gated by a contemporary London-style metal fence. The caption reads: ‘Antony, Analyst, The City, London England, May 2013’. Another documentary-style photo is focused on the trunk of a tree standing on a well-kept lawn, on what appears to be a drab winter day. In the background, behind the tree and out of focus, we see an office building. The caption reads: ‘JP Morgan (formerly Lehman Brothers), Canary Wharf, London, February 2013’. Another shows a beige-greyish stone staircase, the straight and square lines seem indicative of a postmodernist style. The light fall indicates the picture was taken outside. The caption reads: ‘Credit Suisse (Access Denied), Canary Wharf, London England, March 2013’. Another image-document, framed and on the wall, is a print out of an email sent by Curran to the Deutsche Börse. The redacted mail is a response from Curran to the bank’s negative reply to his request to access to record audio and visual material from its office in Ireland. A sense of reveal arises out of the interplay between the captions the documents and images on display. By emphasizing the sites and institutions he has not been granted access to, such as Credit Suisse, Deutsche Börse, and J.P. Morgan, institutions that he describes on his blog as ‘where literally and metaphorically, futures are speculated upon’, *The Market* seems to foreground the inaccessibility and impenetrability of the black box of finance while simultaneously creating a sense of secrecy.[[35]](#footnote-35)

Another example of digging down comes from Eline Benjaminsen’s *Where Money Is Made: Surfaces of Algorithmic Capital* (2017- ongoing), which won her the Steenbergen Stipend and the second prize in the Canon Zilveren Camera Competition in 2017. *Where Money is Made* ‘aims to bring this invisible and obscure economic power to light by tracing lines of algorithmic capital to the places where some of the greatest profits are made today’.[[36]](#footnote-36) Benjaminsen attempts to do so by way of a series of documentary photographs, a short publication designed as a miniature *Financial Times* newspaper on the research done for this project, and a drone-video depicting from bird’s-eye perspective parts of a German landscape where the trade routes of high-frequency trading, laid below the surface by fiber optic cable lines on the straightest path allowed by law, connect major stock exchanges. In the words of Benjaminsen, the drone video shows ‘the physical landscapes of an immaterial market’.[[37]](#footnote-37) Where *The Market* focusses on the brick and mortar of financial institutions and the people working inside them, *Where Money Is Made* centers on the lines of connection by fiber optic cable between financial institutions.

Yet others attempt to probe below the surface in an attempt to find objects of meaning hidden from sight. Take, for example, *75.000 Futures* (2013), a 240-page picture book of colorful charts and graphs on a white background made by the artists Gunnar Green and Bernhard Hopfengärtner. The 75,000 futures of the title are a reference to the Flash Crash of May 2010. It refers to the rapid and unexpected algorithmic sale of 75.000 eMini Futures that, reportedly, contributed to the crash. The ‘world of trade algorithms’, in the words of Green and Hopfengärtner, is both inaccessible and incomprehensible.[[38]](#footnote-38) On the left of each page in this picture book is a noun or word combination, on each right page a set of colorful geometric shapes that show the familiar contours of a graph. Examples, like The Bird, Low Tide, Broken Sky, The Monster, The Blue Pig and Red Sky at Night, The Flood, When the Levee Breaks, and Good Luck Human, use words that clash with the thin, clean lines, the sharp angles, and the colorful diagrams. The collection of 240 diagrams consisting of rectangles, prisms, squares, and triangles with sharp edges work as representations of split-second moments in financial trade history. Each graph outlines the calculation and decision sequence of a trading algorithm.

In addition to the graphs, the name of each of these algorithms is mentioned. With these graphs, the Flash Crash appears as a collection of strictly framed and ordered collection of figures, that, lacking in explanation and context, are just that: a collection of colorful rectangles, squares, straight lines, triangles with sharp edges, and rectangular prisms. The graphs ‘are just a product of our perception and our desire to understand’, Green and Hopfengärtner write.[[39]](#footnote-39) With what seems to be a mixture of fear and fascination, the artists state: ‘We look at the graphs and don’t understand them. […] What they show will trigger more events. But we cannot know how they will occur, what or whom they will befall, where or when they will take place.’[[40]](#footnote-40) What is striking is the focus in particular on high-frequency trading algorithms as causing unpredictable movements and sudden collapses. High-frequency trading is associated with sublime power, unpredictability, and a form of automated yet animated life. Anxiety is laid onto the unknowability of trading algorithms, on its whims and loopholes. Although the causes of the Flash Crash are manifold and difficult to pin down, the behavior of trading algorithms is referenced as a significant cause of future concern.

The recurrence of black-box-related aspects — such as opacity and unknowability — in these portrayals of algorithmic trading is striking. In these thematically different approaches, algorithmic trading is associated with immateriality, opacity, and secrecy, which are considered to be caused due to a lack of access, transparency, and a lack of — tangible — information and documentation. The artists aim to engage with the immaterial, hidden, and obscure spaces of the black box of finance, which results in documentation of what is considered to be immaterial, invisible, and obscure, at least from the outside. The practices begin with the notion of the black box of finance as an obscure, impenetrable, and inaccessible space and end, metaphorically, with a black box as an impenetrable enclosed space. Nothing happens where it supposedly happens: the black box is imagined, represented, and narrativized as an incomprehensible, bounded, and impenetrable space. The urge to dig down to ‘where finance happens’, to localize ‘finance’, to grasp it, is a recurring feature of algorithmic trading portrayals and has been picked up by numerous artists.[[41]](#footnote-41) Such digging down practices represent algorithmic trading as a series of images, objects, and documents that form part of an otherwise obscure, invisible, and evasive realm. The desire to collect, to locate, map, objectify, and document these locations could be understood as an attempt to grasp and relate to algorithmic trading as an object and seems to come from a place of discomfort in relation to the markets perceived subjectivity whose effects are ‘slap, bang, in the middle’.

Features of digging down include images of transmission towers, documentary images of data-centers and data-farms, visualizations of the ‘swoosh’ and speed of data traffic represented as colorful light strokes and bolts, major and minor data transmission cables and towers, and the strict framing of facades of buildings in which financial institutions are housed — a visual language of exploration and transparency. In a sense, these artworks position themselves as a source of visual knowledge, a witness to the hidden-from-view and difficult to access locations where algorithmic trading ‘happens’. Artists locate and enter a hard-to-perceive world and grapple with this invisibility by way of placing it in a specific light, which is characterized by making its vast terrain and secluded locations visible and known in a predominantly materialist and documentary style. This approach runs the risk of creating a skewed picture of the black box of finance, skewed to reproduce and perform its perceived opacity, invisibility, and unknowability. It suggests that by collecting, documenting, and visualizing parts of the hidden socio-technical and architectural infrastructures, we could obtain a better grasp of algorithmic trading. Algorithmic anxiety is here triggered by algorithms that are perceived to defy the limits of vision. It is this invisibility that triggers anxiety, as this lack is associated with the unknown and the uncontrollable. Digging down assumes that when rendered visible, the black box of finance can become known and reigned in. To make visible is to know, and to know is to control. ‘Axiomatic value is given to increased information. […] As if there were a kernel of truth just waiting to be revealed’, which is to say, digging down associates visibility with intelligibility and control.[[42]](#footnote-42) It assumes that only under conditions of transparency, visibility, and access can the black box of finance come within our grasp.

This too suggests that what is latent or what cannot be perceived is of greater importance than what is manifest. Digging down is skewed to the Enlightenment conviction that what is obscured by vision forms a problem of knowledge, and hence an issue of control. It suggests that the black box requires to be accessed, to be opened, so that what is hidden in the dark inside can be brought to light, explored, known and, ultimately, controlled, which also conjures up the spirits of truth-bearing institutions that were involved in unveiling, discovering and exploring assumed ‘dark continents’.[[43]](#footnote-43) At the same time, digging down creates a sense of revelation by its failure to reveal; it delivers by failing to deliver. The question remains what the long corridors with server racks, the architecture of databases, the documentary photographs, the trajectory of cables, the ominous sounds, the graphs, the charts, and bricks and mortar are meant to help reveal about algorithmic trading.

## The Aesthetics of the Inside of the Box: Standing Back

Another dominant imaginary of algorithmic trading takes a different tack: it stands back. Standing back consists of practices that put the knowledge of the ‘innards’ of algorithms to use. For example, aspects of the technical inner-workings of financial trading technology are enacted, mimicked, or mocked. Or, artists develop these technologies proper and design prototypes of speculative designs of algorithmic trading.

Artists taking up this approach aim to deconstruct conventional views on algorithmic trading by imagining trading algorithms as a means to altogether different socio-political ends.[[44]](#footnote-44) They ‘stand back’ from algorithmic trading in order to ‘position them within larger structures of power’.[[45]](#footnote-45) Attention shifts to the discursive and epistemic conditions of algorithmic trading and whose interest it serves. As such, the operations of the black box of finance are imagined as historically-contingent and changeable, suggesting that the financial systems of today could be different when the operations of the black box of finance are relayed and stamped by different power relations. Standing back as an approach imagines algorithmic trading as a dynamic of speculation, valorization, and distribution geared to and steered by major players on the market. Artists who employ this strategy find the heart of the problem to be with the power relations in which they are embedded.

Three canonical artworks illustrate standing back as an approach to algorithmic trading: *The Parasite* (2014), a project of Robin Hood Minor Asset Management (RHMAM); RYBN’s *The Algorithmic Trading Freak Show*;and *Black Shoals; Dark Matter* by the artist duo Lisa Autogena and Joshua Portway. With *The Parasite* project,RHMAM — a Deleuzian hedge fund — designed an algorithm and named it Parasite.[[46]](#footnote-46) The algorithm analyses and tracked transactions in U.S. stock markets and mimics the behavior of successful traders. Like a parasite, it feeds off its host; in this context, it feeds off trading strategies. Yet, like Robin Hood and unlike a parasite, it redistributes the surplus profits it generates. The RHMAM invests its received profits in its own ‘activist hedge fund’ and donates it to activist groups in society. *The Parasite*, RHMAM claims, bends the financialization of the economy for the benefit of those who are not the financial elite.[[47]](#footnote-47) *The Parasite* cultivates ambiguity: it seems like a fraudulent scheme; it could be a hoax, a start-up investment fund created by socially engaged traders, just another art project, or none or all of the above. And that is, in part, the point: *The Parasite* project raises ethical and technological questions about what algorithmic trading is, what it does, and who benefits. It intervenes in the black box of finance by way of piggy-backing inside the box and employs and re-directs the benefits of high-frequency trading algorithms to different beneficiaries and political agendas.

Another form of standing backis exemplified by *The Algorithmic Trading Freak Show* (2013), a project by the art collective RYBN. Displayed as a cabinet of curiosities of algorithmic financial practices, the *Freak Show* offers a collection of financial trading algorithms. RYBN researched the history of trading algorithms from the early 1970s up to today and ploughed through hundreds of scientific research papers, press reports, graphs, and documentation on automated trading. The resulting *Freak Show* is a trove of information about the inner workings of speculative trading algorithms whose pre-programmed instructions proved to be unprofitable, obsolete, and inoperable. Numerous algorithmic experiments have been documented by RYBN, ranging from experiments to explore the esoteric correlation of price variation with astrology, meteorology, numerology, and zoology. One such experiment, conducted in 1998 by journalists of *The Wall Street Journal*, involved a blindfolded monkey throwing darts at pages of *The Wall Street Journal*. The *Freak Show* aims to ‘unveil the esoteric side of finance, to unravel the myths from the facts and the constant competition leading to algorithmic warfare which in turn causes instability, on the markets and in our societies’.[[48]](#footnote-48)

The various documents, research papers, and graphs on display in the exhibition view of *The Algorithmic Trading Freak Show* mimic a *Wunderkammer*, in the style of cabinets of wondrous specimens found by natural scientists or part of a natural history museum’s collection of whimsical and extinct species. Seen in this light, *The Freak Show* could be considered an archaeological taxonomic project *avant la lettre* that belongs to a history of technology museum that exhibits obsolete and failed future-predicting practices of the twenty-first century.

A last canonical example of standing back is *Black Shoals; Dark Matter* by the artist duo Lisa Autogena and Joshua Portway. This work emulates the effects of financial market abstractions and mystifications and ties algorithmic trading models to astrology, which is framed as another model with which humans aim to transcend time and space but have failed to do so. Their installation piece is a visualization of the stock markets that takes the form of a planetarium. The installation, commissioned for Tate Britain in the same year of the dot com bust, consists of a 5-metre-diameter domed ceiling onto which a computer display is projected showing tiny blinking and glimmering stars. Each star represents a trading company and each blink a trade in shares, resulting in a dreamy, twinkling night sky. And when a stock crashes, the stars fall from the sky and disappear from view, leaving black holes.

The ‘Black Shoals’ of the title is a reference to the mathematical Black-Scholes model, a formula based on the work of, amongst others, mathematicians Fischer Black and Myron Scholes. This formula attempts to calculate the value of a share option in order to lower the risk involved in investing. Two of its developers set up a hedge fund, Long Term Capital Management, which made impressive profits and became a major player on the financial market — until it wasn’t. Suddenly, over the course of a few turbulent days on the market in the year 1998, the company nearly collapsed when an unexpected and unprecedented crash occurred, losing an estimated couple of billion dollars in two days. What is more, to stall a domino-effect, sixteen financial institutions agreed to a back-stop to bail out Capital Management under the auspices of the Federal Reserve. The title of the artwork tacitly but poignantly points to both to large-scale epistemic failures of trading algorithms as well as to the messy power relations operative in algorithmic trading: regulators and Central Banks are deeply involved in the very same operations they are tasked to regulate and manage. The artists understand the sudden collapse of Long Term Capital Management, a company that seemed too big to fail until it failed, also ‘as a kind of Icarus parable for those attempting to control complex systems’.[[49]](#footnote-49) ‘*Black Shoals* was designed as a kind of parody of the trading desk of the übermensch — the Mount Olympus from which they would survey their creation.’[[50]](#footnote-50) Seen in this light, the dome is a jab at human attempts to reach a view from nowhere and have bearing on the cosmos — on prediction as divination. By enacting these metaphors and, hence, the world called into being with these metaphors, *Black Shoals; Dark Matter* emulates what a certain mode of thought *does,* whilst subtly nodding to the politics that result from it. It critiques by mimicking, replicating, and emulating finance as a depoliticized divine force of nature which is therefore out of human’s reach or control; a materialized, critical and yet ironic version of the financial sublime.[[51]](#footnote-51)

While each of these projects come with its own strategies, they share a focus on and a use knowledge of how trading algorithms operate — on the inside of the black box. This leads to works that either visualize this knowledge, or tinker and toy with these technologies, or mimic and mock in order to reconsider the rationality behind trading algorithms, inviting their viewers to rethink the uses and implementations of algorithmic trading — the output of the black box. Both digging down and standing back aim to illuminate aspects of the black box of finance: digging down offers the revelation of hidden mysteries; standing back offers the pleasure of outfoxing — the pleasure of mystification; the hope of last-shall-be-first. As both strategies are pitted against their own perceptions and representations of algorithmic trading, change is sought by both in engagements within the bounded of and enclosed space of the black box of finance.[[52]](#footnote-52) The question remains: After the mapping and documenting and after tinkering with and mimicking the finite aspects of algorithmic trading, what is the road to the possible?

## Re-imagining the Black Box of Finance

Over the past few years, artistic engagements with the financial markets have emerged which do not stand back or dig down, but position algorithmic trading within layered and interrelated historical, technological, and environmental developments. In these works, trading algorithms are imagined as ‘entangled, mediated, connected, interdependent, intertwined’ and different sensibilities, a mix of influences, and orientations give shape to imaginative horizons that serve as guides to alternative imaginaries of the future of automated capitalism.[[53]](#footnote-53) The following section analyses this imaginary by conducting close readings of the work of Emma Charles and Femke Heregraven. The artworks of these two artists offer constellations that reach beyond and above the black box of finance, mixing the spiritual and the material, broadening the field of relations to algorithmic trading, and opening it up to the possible and to spectral interventions.

## Conjuring Spirits in the Black Box of Finance

We see these themes at work in Emma Charles’ *Fragments on Machines* (2013), a 17-minute experimental piece of docufiction. Something burrows beneath or beyond the predominantly cyber-utopian and cyber-dystopian accounts of algorithmic trading. This filmevokes the mythical figures of a hybrid, a specter, and the metaphor of a flood to represent algorithmic trading. Charles’ much-accoladed video essay has been included in numerous exhibitions on information technology, and has garnered both popular and critical attention.[[54]](#footnote-54) In the spirit of Marx’s *The Fragment on Machines*, Charles’ video essay focuses on human–machine relations. The title of the film is a reference to Karl Marx’s *Outlines of the Critique of Political Economy*, in which he discusses the evolution of the production of labor and capital, from the division of labor to the increasing integration of machines in labor, and to the ever-increasing automatization of labor.

In Charles’ video essay, the opening scene of the first chapter — titled ‘Metropolis’ — portrays Manhattan’s Financial District from the vantage point of a train crossing the Manhattan Bridge. The camera captures the skyline of Lower Manhattan which, with its square blocks of skyscrapers and cube-like façades of Art Deco buildings, provides an association with the black box of finance. By portraying the architecture of New York’s Financial District from a distance and from the outside, Charles alludes to inaccessibility. The camera then cuts to medium close ups of the façades of the skyscrapers and of some of the main Art Deco buildings. In doing so, *Metropolis* sets the scene for *Fragments on Machines* smack in the middle of Manhattan’s Financial District with its iconic and idiosyncratic plate-glassed skyscrapers, mixed with Art Deco architecture dating back to the days of heavy manufacturing for which these buildings were used in the early 20th century.

In a poetic tone, a male voice-over narrates:

I was once lost in the city; now, I don’t know where to disappear anymore. I exist in two states. I remove the animal from myself as animals are removed from the city. Undetected and unnoticed, they disappear. Slowly, the natural becomes unnatural. Slowly, the city evolves.

The streets of New York’s Financial District are almost empty, with just a few people in sight. The voice-over continues:

The spread of intelligence across Europe can be mapped, like an incurable epidemic of knowledge. In the place of public readings, came reading in private, in silence. The secrets of what never happened, in the end, cannot be burned, they multiply and imprint in every corner… I live through the structures and on the structures that have been planned by architects, designed by vibration, washed through with information… I stood before the source, an empty tomb. To be closer to the source is all I needed. The trucks could roll from their momentum, even with the brakes on. Their housings were dockside palaces. Treasure would travel hundreds of miles over days […] A new king lives here.

A series of shots of fiber markings, manhole covers, street-level signs of underground utility ducts, and an industrial air ventilation system indicate that we are milling around the financial markets, located within the edifices of the depicted institutions and corporations.

The video’s next chapter,titled‘Servers’,takes the viewer beyond the façade of an edifice in the Financial District and into the building’s empty hallways where ‘the new king’ allegedly resides. The sepia-colored, dimly-lit architecture of the building’s foyer contrasts sharply with the bright white, tungsten-lit server room that the camera enters. The cut between the shot of the hallway and that of the server room hints at the film moving from the outside to the inside of the black box of finance. Inside, behind the walls of the lavish but decaying Art Deco architecture, we find what looks like a data center. A door opens, and then another, and another. The room entered is filled to the brim with mainframe computers and server racks.

Figure 4: Production still *Fragments on Machines* by the artist Emma Charles.



Figure 5: Production still *Fragments on Machines* by the artist Emma Charles.

The supposed new king of Wall Street is personified by an *acousmêtre* (a first-person, disembodied voice-over) and given a semblance of embodiment through a series of shots of aspects of the infrastructure of algorithmic trading. Numerous Art Deco buildings in the Financial District now house parts of the infrastructure of post-industrialist financial capitalism’s new king. Data centers are dotted around the Financial District, and their physical location is important. The closer a high-frequency trading company, brokerage, or bank is located to the servers (that is, the closer it is to the source), the faster its algorithms can respond. What appears to exist in an ether as an immaterial, invisible, and omnipresent structure is represented as connected, strap-attached to, and kept on leash by rubber, fiber, copper cables, and brick.

The dialectic relationship between the words of the narrator and the images in *Fragments on Machines* associates the computational infrastructure of the financial markets with, in the words of the narrator, an ‘incurable epidemic of knowledge’. The narrator metaphorically connects this ‘incurable epidemic’ to ‘trucks rolling with brakes on’. The imagery of an epidemic and of moving trucks suggests prevalence, development, spread, movement, *and* inevitability with regards to the new forms of productivity that have come about — the algorithmic automatization of the financial markets. At the same time, the cause of this seemingly inevitable development could also be taken as a reference to a primary mover, or even to a force of nature, or the preternatural.

The voice-over continues:

My muscle has been replaced by flex and copper; my brain a server. Ones and zeros, my voice. I exist as a phantom under iridescent color. I speak in shimmering tones to the hidden construction of the form. I desire to become data. I will be mobile, moving to provide. I will become the information flow. I am your personal relationship to the source. I become more and more. I move in and out of position several times a day. I adjust by fractions to adapt to my surroundings.

Rooms filled with copper and fiber-optic cables, computer servers, air ventilation, and cooling systems that facilitate algorithmic exchange have to an extent replaced a form of labor time and productivity which previously involved the body. The embodiment with which Charles represents algorithmic trading is given the form of a disembodied, conscious voice, a phantom-like hybrid organism existing in ‘two states’, human and machine, natural and unnatural, residing in New York’s corporate Financial District.

Hybrids are charged with meaning, which raises the question: What is the meaning of the hybrid figure of algorithmic trading? In the history of science, hybrids were part of a larger cluster of prodigies, as Lorraine Daston and Katharine Park explain in *Wonders and the Order of Nature,* an exhaustive chronicle of wonder that covers more than a thousand years of ‘wonders of nature’: strange, rare, and extraordinary phenomena which ‘straddled categories’.[[55]](#footnote-55) Wonders had to be rare, mysterious, and real to be considered wonders, Daston and Park explain.[[56]](#footnote-56) Over time, some objects lost their status as wonders for various reasons — for instance, the basilisk was debunked, comets explained, and unicorn horns became too common.[[57]](#footnote-57) At the same time, new objects joined the canon of wonders, such as monstrous births or snow in summer.[[58]](#footnote-58) Some such anomalies were considered as ‘enhancing the beauty and diversity of the world’, while other singular anomalies were considered prodigies, ‘divine messages and signs of things (usually undesirable) to come’.[[59]](#footnote-59) The category of the prodigious included earthquakes, eclipses, conjoined twins, unseasonable thunderstorms, examples of peculiar animal behavior, and other phenomena that were seen as ‘outside the order, movement and operations of nature’.[[60]](#footnote-60) Daston and Park note that by the last quarter of the sixteenth century in Europe, a specialized, canonical body of medical study on the causes of monsters was well established. Monsters, according to this literature, were caused by the violation of moral norms. Daston and Park point out that the category of the ‘monstrous’ did not spring from the blurring or exceeding of categories per se — which anthropologists such as Mary Douglas later placed at the heart of ideas of pollution. Rather, only when such blurring of categories was taken to be caused by the violation of moral norms was it considered monstrous.[[61]](#footnote-61) Hybrids, however, were the exception.

Hybrids were seen as caused by ‘abhorrent’ behavior and therefore generally considered a sign of sin.[[62]](#footnote-62) Images of demons, which served as a reminder of sins to be avoided, were frequently represented as hybrid figures, further emphasizing their association with sin and punishment.[[63]](#footnote-63) Prodigies, Daston and Park chronicle, were taken to be the precursors of dramatic, local, and usually catastrophic events: epidemics, floods, famines, fires, and wars. Featuring a hybrid figure as the *acousmêtre* of *Fragments on Machines* and associating a hybrid being with algorithmic trading brings to bear moral transgression, if not a premonition of God’s wrath. This leads one to ask: ‘What moral transgression brought the hybrid into being?’

Charles alludes to the automatization of labor as a possible cause. On the floors and in the offices that *Fragments on Machines* depicts, we don’t find white-collar workers sat in cubicles. The camera pans along the lines and grids of server rooms, cables and wires in all colors, air ventilation systems, computer buttons, rubber tubes, and along endless, brightly lit corridors and aisles full of whirring machines where the activities of algorithmic trading are supposed to ‘happen’. The film shows an abundance of images with no human in sight. Here, Charles seems to allude to the *Grundrisse*, in which Marx contends that machines become an abstract, dominant power in the production of capital, enveloping humans and leaving workers scattered. According to Marx, this increasing reliance on machinery takes two forms. One is the development of machinery in which the mass of labor and the entire production process that enabled it has vanished from view, consumed by the machine. The second is the integration of these machines as a means of production for capital in a global market. Taken together, the development of human-labor-replacing machines as a means of production for capital in the world markets indicates the extent to which general intellect has become a tool for the ruling class.[[64]](#footnote-64) In Charles’ *Fragments on Machines*, workers seem to have been replaced by machines. Humans have no function other than to keep the machines of automated financial capitalism up and running. The desolate and quiet images of Wall Street depicted in the previous chapter of the film are contrasted with the whirring and zooming sounds of server rooms, cable rooms, and generators that now occupy entire floors in buildings. Where once humans congregated, vents, server racks, loops of cables, and countless pipes and tubes have taken their place. The film’s images show empty chairs, empty halls, and empty cubicles. Further emphasis is placed on water, from images of clogged cooling systems to rusty and leaky pipelines to images of cesspools. In *Fragments on Machine*s, the workers that still exist are maintenance workers, such as technicians, cleaners, and doormen. The heart of financial capitalism has largely been emptied of human traces; manual labor has been replaced by machine labor and a ghost-like figure remains.

Depicting New York’s Financial District as an eerie space, emptied of most human labor but where a ghost-like agency lingers, also invokes the specter of communism, from the famous line from Marx and Engels’ *Manifesto of the Communist Party* (1848): ‘A specter is haunting Europe — the specter of Communism.’ In the Manifesto, the specter indicates the persistent presence of the communist spirit in the fragmentized and incoherent activities of the proletariat scattered all over Europe. Conjoined and unified, their spirited activities may at some point in time incite a revolutionary struggle. Felski writes:

[N]ew actors jolt alongside those with thousand-year histories; inventions and innovations feed off the very traditions they excoriate; the past is not surpassed but revisited, repeated, surrounded, protected, recombined, reinterpreted, and reshuffled.[[65]](#footnote-65)

In *Fragments on Machines*, Charles ascribes a certain kind of spectral agency to algorithmic trading; it is thus given the power to act, wittingly and consciously yet invisibly, as well as the ability to cut through time past and present. *We* might see no-body or nothing, yet *it* sees everything.

Charles’ use of a specter-like figure is metaphorically and conceptually equivocal. In *The Spectral Metaphor: Living Ghosts and the Agency of Invisibility*, Esther Peeren explains that specters in contemporary culture and theory ‘are methodologically distinct and vary in the characteristics, functions and effects they assign’.[[66]](#footnote-66) However, she distinguishes between three interrelated emphases within their usage in contemporary culture. Firstly, there is the ghost as the figure of return, expressing the persistence of the past in the present. Secondly, the ghost as a figure of presence-absence, ephemeral yet present in space as a matter that needs to be accounted for. And lastly, the ghost as a figure of mixed and hybrid phenomena, a conceptual figure of critique of the ‘unmixed’ and ‘pure’.[[67]](#footnote-67) Ghosts indicate an agency that is present yet invisible and intangible, an eerie, hybrid entity. Described by Mara del Pilar Blanco and Esther Peeren as an ‘unruly’ and ambiguous figure, a ‘non-present present’, a ‘being-there of an absent or departed one’, they ‘signify precisely that which escapes full cognition or comprehension […] what is placed outside, excluded from perception’.[[68]](#footnote-68) Ghosts have a penchant for lingering and haunting, often demand a response, and are associated with the preternatural and with simultaneous and mixed temporalities and categories.[[69]](#footnote-69) Specters are unruly and ambiguous in the sense that they represent the bodiless presence of things that are conventionally conceived as disparate or even opposed: past and present, materiality and immateriality, the real and the imaginary, immanence and transcendence, and primary and secondary causes.[[70]](#footnote-70) To state it in a more accurate way, they cut through the limits and walk through barriers of the order of things. ‘The specter stands for that what never simply is and thus escapes the totalizing logic of conventional cognitive and hermeneutic operations’, Peeren writes.[[71]](#footnote-71)

Finance and money in general and algorithmic high-frequency trading in particular have a track record for being associated with mystifying, spectral, and gothic qualities.[[72]](#footnote-72) The *acousmêtre*, combined with images of vacuous office buildings and the haunting and ominous soundtrack that accompanies the film’s images, invoke the spectral dynamics of capital described by Mark Fisher in *The Weird and The Eerie* as ‘at every level an eerie entity’.[[73]](#footnote-73) Capital, he argues, is ‘conjured out of nothing’, yet exerts palpable influence.[[74]](#footnote-74) Fisher describes the eerie as ‘tied up with questions of agency’.[[75]](#footnote-75) It can be found in places ‘where the forces that govern mundane reality are obscured’, where an unknown agent seems to be acting with fate and foresight.[[76]](#footnote-76) Eerie places, as Fisher phrases it, are ‘landscapes partially emptied of the human […] where there is nothing but should be something’.[[77]](#footnote-77) The ‘something’ that is missing in *Fragments on Machines* might be the human.

The soundtrack foments the eerie suspense of the images of desolated offices, with its continued sounds of running and dripping water mixed with the sounds of a fire alarm, cut through with images of pools of water, rusty pipes, and broken cables These sounds and images stress both the entropic nature and the excessive use of energy of these parts of algorithmic trading. Repeatedly, Charles shows images of bodies of water, eroding copper wire, cesspools, and clogged cooling systems, and then cuts to images of the currents of the Hudson River. Further, a disembodied voice that now lives where humans used to dwell mentions daily activities and its desire to become an information *flow* with a direct link to ‘the source’. The textual and visual emphasis on liquidity and fluidity in each chapter of *Fragments on Machines – ‘*flows of data’, ‘washed through’ — is combined with the repeated images of water pools and dripping and leaking tubes and becomes increasingly pronounced throughout the film. The final scene of ‘Servers’ depicts the Hudson River seen from a window inside the data center and inside the home of the ‘new king’, hinting that it is the new king that looks out on the Hudson. A sound bridge reinforces this view. It consists of the sound of streaming water, which is carried to the final chapter, titled ‘Flood’. In doing so, the sound bridge connects the perspective of the ‘new king’ to the first scene of ‘Flood’ which depicts the current of the Hudson. Visually and sonically, Charles links algorithmic trading to the Hudson and to approaching danger.



Figure 6: Production still *Fragments on Machines* by the artist Emma Charles.

Meanwhile, the ambient and ominous musical score is foregrounded and becomes ever louder throughout the final chapter. Tracked by the haunting sound of an alarm creating suspenseful tension,the camera moves outward, from the edifice of the data center and out of the Financial District onto a ferry on the Hudson River heading in the direction of New Jersey. The voice-over narrates:

The river flows and undulates underneath. Underground, organized tributaries completing the feedback loop. I was drawn in by the trickle of the stream, the meagre beginnings. The undulated notes that cascade on top of one another, collecting and forming to lead me on... A million pounds will roll into the sea, dissolve, burn, blow away. You will never breathe the ashes, nor will you drink the pulp.

A seemingly prodigious teleological event awaits the viewer in the final scene. *Fragments on Machines* ends with images of the flooded Verizon data center building in the Financial District. Several floors of the building, a key switching facility for interconnecting and storing communications, sustained severe damage from flooding during Hurricane Sandy in 2012. According to the voice-over, it took weeks and a million pounds to replace and repair. The damage done by Sandy was a reminder that, despite the concept of the cloud, data travels through software and hardware and through urban environments in which a flood can grind all traffic and operations to a halt for weeks on end. The communication technology on which algorithmic trading depends is ‘prone to weather disruption’ and sensitive to rain, fog, snow, and water.[[78]](#footnote-78) The seeming otherworldliness of algorithmic trading is framed and grounded in concrete matter, Charles seems to suggest.

The next and final scenes of *Fragments on Machines* show men dressed in green and white coveralls mopping and sweeping a flooded floor. With this ending, Charles connects algorithmic high-frequency trading to the damage sustained by an extreme weather event and to a flood. A flood is an ambiguous and versatile metaphor, too. Flood stories are numerous, stretch over epochs, and cross and cover all continents. In European mythologies, amongst others, a flood or deluge is more often than not sent by some kind of deity as a result of a conflict between deities or as the fallout of god’s wrath. Charles leaves the signification of the flood in *Fragments on Machines* open to interpretation.When understood as a metaphor for the ‘new king’ of algorithmic high-frequency trading, wrath is upon us. In another reading, the apparatuses of financial markets that use up so much energy are linked to the natural catastrophes global warming engenders. And interpreting the flood in biblical terms, yet another narrative arises.

In *Noah and the Flood* — the flood narrative in the *Book of Genesis* — God sends his judgment of the wickedness and corruption of the world he created in the form of a flood, as a means to wash the world completely clean. The flood wipes all creatures off the face of the earth save for Noah and those with him in his Ark, turning the earth into a massive pool of water. After the flood, God asks Noah to remake and repopulate the earth. Interpreted in these terms, the flood connects algorithmic trading with a sphere or realm outside the seemingly all-encompassing black box of finance and points to the influence this ‘outside’ can have on the vulnerable infrastructure of algorithmic trading. It points to that which cannot be predicted or financialized, to that which cannot be protected by risk management or insurances, and to possible consequences that exceed the expected.

Can we relate to this ambiguity without mystifying it? Can we engage with this mystical and teleological metaphor without depoliticizing algorithmic trading? The answer is yes. Floods and other natural catastrophes have become a financial product, a speculative object. Financial markets quantify and price possible natural disasters in so-called ‘catastrophe bonds’; that is to say, probable future scenarios involving natural catastrophes happening at a specific time and location have become a financial instrument. If such catastrophic events actually occur, they don’t merely affect those involved but also entail profits for the investors of the said catastrophe bond. Melinda Cooper explains:

[W]hile weather-related risk had once been covered through indirect means, such as property insurance, the contingencies of the weather could now be directly hedged and traded in the capital markets. The curious effect is that climate change—and the critical or singular events it may engender—has become a speculative opportunity like any other in a market hungry for critical events.[[79]](#footnote-79)

These bonds turn disruptive events where a great deal of uncertainty and risk are involved into financial opportunities for investors. In other words: catastrophe derivatives. The result has been ‘financial instruments designed to price and trade both in the uncertainties of the weather and our own uncertainties about the future of climate change’.[[80]](#footnote-80) Further, the irony of Hurricane Sandy is hard to ignore: the flooding of much of the Financial District caused the New York Stock Exchange to close for the first time in almost three decades and, tellingly, algorithmic trading was closed for two full days. A flood seems to be an equalizer, devastating all that it comes to pass and making everything an unrecognizable pool of muddy water.

Ambiguous and quasi-religious metaphors recurin *Fragments on Machines*. In addition to a flood, algorithmic trading is associated with an eerie urban landscape connected to a hybrid, conscious, ghost-like, and possibly prodigious figure, and it seems to presage the coming of a catastrophic force. Each of these metaphors elude clear theorizations and that seems to be the point*. Fragments on Machines* shapes an imaginary of algorithmic trading as a phenomenon as ambiguous as specters, hybrids, and floods. What does *Fragments on Machines* reveal when it imagines trading algorithms this way? It hints at factors of influence that, though outside the brightly lit, squarely bounded, and straight-lined space of the black box of finance, nonetheless affect contemporary economics. In this process, the mechanical, boxed, linear infrastructure and the urban grid of algorithmic trading are imagined as mutually constituted by a re-pastoralized landscape which includes a transformative encounter with a force of nature. To conceive of algorithmic trading by way of associating it with the figure of the specter — with an eerie and prodigious space that is, save for a few maintenance workers, devoid of human presence — and to tie it to a flood is to conflate and recombine that which is usually considered categorically distinct. Algorithmic trading is imagined here as internally related to, and mutually constituted by, financial and natural history, economy, and theology, and to exist between the probable and the possible. Instead of swapping one dualism for another and instead of furnishing algorithmic trading with all-capturing power relations, or imagining the black box of finance as mystical or otherworldly, Charles connects the porous, entropic matter of algorithmic trading technologies with the constant manual labor and maintenance work it necessitates and adds to this a Marxist revolutionary trope and biblical imagery of sin, punishment, and new beginnings.

Many phenomena that represent algorithmic trading as an open system come together in *Fragments* *on Machines*. The constant maintenance work cannot prevent trading catastrophes*, Fragments on Machines* seems to suggest, as the black box of finance is not a closed system. This maintenance work happens on all levels, from the tweaking of algorithms by programmers, to the work done by cable guys, to the interventions by central banks and governments, none of whom are able to predict the future or transcend time and space. Giving constitutional significance to myriad metaphors and symbols charged with ambiguity invalidates dualisms and provides algorithmic trading with many ties to the world. Similar to water, a recurring visual trope in the film, algorithmic trading runs in every direction, affects everything it comes across, and is affected by what it encounters on its course, but not in equal measure*.*

*Fragments on Machines* suggests that illuminating the conceived obscurity, immateriality, or intangibility of the black box of finance would not give way to more democratized, less obscure, or manageable financial markets. Rather, it imagines the black box of finance as part of a far larger, open, and ambiguous constellation that connects the present-day hardware and software of algorithmic trading to the dock palaces of yesteryear, to an extreme weather event, and to a possible new testament.

## Deus ex Black Box

Where Charles represents the black box of finance as an open system that’s open to movers and shakers, Femke Herregraven, points to where such movers and shakers may sneak in: in the spaces between model and reality. In her video installation *Pull everything, pull everything* (2018), Herregraven engages with the Flash Crash of 2010 and also conjures up the figure of a ghost. Further, she explores the connections between algorithmic trading and loss of faith in relation to the classic tragic notion of catastrophe and the theatrical device of the Deus ex Machina.

*Pull everything, pull everything* is a 5’35” loop shown on a two-channel video installation. One monitor of the two-channel installation depicts a configuration of trading desks in an office setting. The setup of each trading desk is the same: a chair, a desk with a landline phone on it, a configuration of three black monitors, here and there a drawer cabinet, and against the office wall stands a set of black server racks. When in operation the three screens atop each desk provide a trader with all necessary and desired information to trade. The desk, chair and the three monitors are set up in tune to the trader’s eye movement. Allegedly, the composition of the information provided on the screens is presented in order of importance and attuned to the brain-eye coordination to process information as fast as possible. The second monitor of shows a black screen. At the bottom of which one can read the existential reflections of a former, anonymous trader on the events of May 2010. The two screens are suspended from the ceiling by a monitor arm.

Figure 7: Exhibition view of *Pull everything, pull everything* by artist Femke Herregraven.

The loop of *Pull everything, pull everything* begins by depicting the underside of the trading desks and then moves smoothly and swiftly around the desks in circular movements. The camera rotates around the desks in the trading room for the first few minutes of the loop. A line of text appears at the bottom of the second screen in white lettering against a pitch-black background. The black screen provides a visual association with the black box. Line by line the following text can be read:

May 6, 2010, 2:32 p.m. EDT

The flash crash was an event for me,

that… well,

it was a defining event

There was no way for me to ignore that

Everyone was on the high-frequency trading floor

Things were going pretty normal

as normal it can be

The market was down 2.5 percent

There were riots on TV, in Greece

and every time they showed the Greek riots

the market would drop a little

and

I remember looking up

and, like on every trading floor, CNBC is on

And I saw the Down Jones dropped another 100 points

A minute later I look up

and then dropped another 100 points

I got up from my desk and walked over to the futures traders,

and they are scrambling all over the place

They don’t know what’s going on

They had huge amounts of orders in the market

Everything is going crazy

The market starts dropping another 100 points

And the CEO of the firm comes running out to the floor,

And he’s just screaming: “pull everything, pull everything”

And so they’re just hitting it

Hitting buttons, turning everything off, everything off

And so we are all huddled around these two screens,

and the one screen we’re looking at the book,

It’s the futures market:

you have a set of people willing to buy,

and a set of people willing to sell.

That is the market.

At this point, on the first channel, the landlines on each desk are suddenly and simultaneously lifted from their desks, followed by the monitors, and then the chairs are lifted from the ground, followed by the trading desks and the server racks, and lastly the walls of the trading room let loose and all are elevated up in the air and all start to swirl around. In medium shot, a configuration of trading screens rotates in the middle of the screen.

The text on the second monitor reads:

And as we are watching the screen,

the orders just started drifting,

The orders were being cancelled

And then they started drifting more

and then they started to go off the screen.

And then they were gone.

There was nothing.

There was no market.

For moments,

for seconds,

there was no market.

And we are all just sitting there and staring into oblivion.

You have no idea what’s about to happen.

Something indescribably horrible must have happened.

The market was gone.

You don’t know if the world is coming to an end

What is happening?

Even 9/11 didn’t have that kind of impact

On the first channel, the swirling of the trading office its furniture and equipment slows its pace. And slowly, all the furniture and equipment lands smoothly and softly back on the floor and comes to rest in its designated place, as if nothing happened. The camera continues to pan around the trading room.

The text on the second monitor reads:

So then, things just started to return to normal

The market recovered and bounced back

And everyone just kept going

For me,

it just changed me

Looking back on that day,

I lost faith in capitalism

Or at least in what we had built

And I didn’t trust it anymore,

I lost trust

After the screens fade to black for a second, the looped video channels restart. *Pull everything, pull everything* engages with the speed and the absurdity of the Flash Crash when algorithms, meant to calculate and manage risk, went haywire due to a mix of causes. The events of the Flash Crash point to a tragic structure within algorithmic trading. Using algorithms, traders attempt to predict regularities and exploit the uncertainty, volatility, and contingency of the financial markets. In an attempt to outpace and surpass their algorithmic competitors, traders design more and more algorithms and develop more and more mathematical models and strategies. This dynamic algorithmic meshwork of high-speed interactions produces its own volatility and contingency. The machines invented to disclose uncertainty and unpredictability sometimes create it. What is more, the trader of *Pull everything, pull everything* gives a first-hand, insiders’ perspective on the Flash Crash, and yet he, an insider of the black box of finance, claims to remain in the dark as to what happened that day. He merely describes what happened on the screens of a cybernetic economy; he is watching the outputs of the black box of finance from moment to moment, from the outside. ‘We are watching the screen,’ he says, as if traders are observing ‘the market’ from the outside, although arguably they are partisan players of state-protected automated trading.[[81]](#footnote-81) In the absence of conclusive causality and the unprecedented impact that it had, the Flash Crash had become a mystical experience to this trader and his account of that day becomes a conversion story. The existential pondering and the re-telling of the event of that day is not merely an attempt to re-capture, narrativize, and give meaning to the Flash Crash in human-time in theage-old form of the first-hand eyewitness account. The story of the trader in *Pull Everything, pull everything* is a story of shaken beliefs, of life-changing moments, and of losing trust in a certain idea and image of the world as a market. This is a moment in which the spectral and prodigious qualities of the black box of finance appear.

Prodigious moments draw their appeal ‘from their rarity and the mysteriousness of the forces and mechanisms that made them work,’ Daston and Park write.[[82]](#footnote-82) Partly because prodigies were ‘unique phenomena fascinating precisely because of their unknown causes and their violation of expectation about type’, partly because of their ‘occult qualities’ that ‘could only be determined by experience rather than reasoning’, and largely because God sent prodigies to warn of approaching evil.[[83]](#footnote-83) In a sense, the flash crash appears as contemporary prodigy: a normative break, a ‘rupture’ in the order of things associated with apocalyptic catastrophes.[[84]](#footnote-84) The category of the prodigious draws from instability and the unknown, which involves concerns about the future disposition of the self and which seizes you, in the words of Kierkegaard, *‘*with the suddennessof the enigmatic’.[[85]](#footnote-85) As the trader of *Pull everything, pull everything* phrases it: ‘You don’t know if the world is coming toan end. What’s happening? Something indescribable horrible must have happened.’ For the trader the Flash Crash was prodigious. A singular event of unknown causes, that defied causal mechanisms, challenged his firmly held assumptions and triggered intense anxiety. In other words, a system aligned to the finite and the probable was disrupted by the possible.

An ambiguous agency occurs in *Pull everything, pull everything*, reinforcing mystification around the Flash Crash. An unknown source or force elevates the traders’ desks from the ground and rotates them in the air. *Pull everything, pull everything* inserts a mysterious, invisible, omnipotent agent that seems to pulls the strings in the trading room. High-frequency trading is associated with a form of invisible, automated, yet animated life. The occurrence of black box related aspects, such as invisible and unknown causes, further adds to a quasi-religious and prodigious sphere. The trader’s conversion story, laden with apocalyptic and Christian tropes, also foments the mystique surrounding the Flash Crash event; an event that put order, rationality, and probability — the models with which traders approach the world and the reality of that world — in doubt. To ‘crash’ is to move beyond what is considered to be the normal, the expected, the predicted, and the anticipated. In *Pull everything, pull everything,* it entails a move into the realm of the mystical and the unknown. The Flash Crash is associated with the indeterminate, the unsettling, the unprecedented, the deviant; with situations in which one does not know what comes next; and with situations in which calculations and rationalizations are unhelpful. The text on the monitor continues:

and then they started to go off the screen.

And then they were gone.

There was nothing.

There was no market.

For moments,

for seconds,

there was no market.

And we are all just sitting there and staring into oblivion.

You have no idea what’s about to happen.

Something indescribable horrible must have happened.

The market was gone.

You don’t know if the world is coming to an end

The trader’s screen, a (black) rectangle, a historical signifier of order, had become a space of chaos, unpredictability, and uncertainty. A seemingly enclosed black box turned topsy-turvy. This event challenged the central assumption of capitalist risk exploitation, resulting in a break with the regular, the familiar and the known. The Flash Crash was for the trader the moment when what was previously considered as identical, split apart: model and reality.

Models, Jess Bier and Willem Schinkel write, ‘perform particular conceptions of the economy, and by extension the world. These conceptions include both implicit and explicit claims about what the economy is, what it’s for, and what it should be’.[[86]](#footnote-86) Writing about the Black-Scholes model and relying on the work of Michel Callon, Donald makes a similar argument in *An Engine Not A Camera: How Financial Models Shape Markets* (2006): models trump reality—or, theory trumps practice. In a self-referring and self-confirming loop, MacKenzie argues that economic theories and trading models perform and hence shape the operations and processes of financial markets. Model-makers, he states, imagine the financial market as predictable and controllable. The models built on this assumption subsequently perform it. He writes: “[t]he effects of the use of the Black-Scholes-Merton model in arbitrage thus seem to have formed a direct performative loop between ‘theory’ and ‘reality’.[[87]](#footnote-87) The model, and the practice it sustained helped to create a reality on the market that confirmed the theory of the model.[[88]](#footnote-88)

Steven Levy makes a similar point in *A Spreadsheet Way of Knowledge* (1984). Models, he claims, are both a tool and a world view, a belief that the way the markets work in turn shapes the operations in the markets. Until they don’t. For the trader, the economy and by extension the world is a market where people buy and sell. If the world as a market is a given, the buying and selling on that market is a given too — the market is space and trading is time. However, when model and reality split apart, the absence of buying or selling is the end of time. Within this view, a crash of the markets is an incomprehensible and all-encompassing event like ‘the world coming to an end’. The nose dive of the Dow Jones and the subsequent cancellations of orders on the market had the trader of *Pull everything, pull everything* losing his ersatz religion. If what makes the world spin is imagined as a market, then activities on it amount to either buying or selling. Consequently, the absence of buyers and sellers is the end of the world, a be-all-and-end-all experience. The Flash Crash could not be absorbed into a logic of buying or selling and therefore was considered by the trader as a threat to the order of the market and, by extension, the world. When there is no market, there is no movement; hence, the world stands still. The market is conceived asspanning the globe and defining meaning in relation to it. In *Pull everything, pull everything,* the black box of finance is not a separate realm nor a bounded space, but an overcoding of and overemphasis on the idea of the market. The idea of the financial market does not determine what happens in it.

The focus in *Pull everything, pull everything* is on the futures market and on how high-frequency trading algorithms caused a sudden collapse. As such, the black box of algorithmic trading comes to be associated with vulnerability, fragility, and the threat of possible collapse. *Pull everything, pull everything* could be considered as a contemporary version of the modernist obsession with dualisms. Such a dualist understanding of Human versus Technology, of the visible versus the invisible, and so on assumes the primacy of one over the other. Seen in this light, the story of the trader becomes a metonymic reference to the often-used Romantic humanist ‘rhetorical device of the reversal’: the machines of reason have gone crazy; the tower of Babel has collapsed; Icarus has crashed down; we have birthed a monstrous child; the very systems built to transcend the present and secure the future — for a split second — unexpectedly punch you in the face.[[89]](#footnote-89) Or in this case: the tragicomic scene of traders feverishly hitting buttons and the desperation they exude as they try to hold on to the illusion of control. A world mired in necessity and probability is slapped to its senses by the possible.

However, the exhibition view of *Pull everything, pull everything* also points to a very different lineage and constellation in which algorithmictrading is embedded. The work was first exhibited as part of Herregraven’s first solo show, *A reversal of what is expected*, at the Westfälischer Kunstverein in Munster. With *A reversal of what is expected,* Herregraven investigates the concept of catastrophe in relation to international finance and algorithmic trading. The exhibition text, written by Kristina Scepanski, states:

Derived from the Greek, this term [catastrophe] was initially not negatively connoted in any explicit sense, but meant instead a reversal, an unexpected change or (quite literally) a movement from a higher to a lower position. In this context… catastrophe is not really a sudden, singular event, but rather a continual unfolding process, which undermines existing systems and leads to regulation of one kind or another.[[90]](#footnote-90)

Upon entering the exhibition space of *Pull everything, pull everything* visitors would see two black screens suspended from the ceiling by a monitor arm, alluding to the screens on the traders’ desks. To be able to watch the loop on the suspended two-channel installation, Herregraven lets the visitors tilt their heads,, bend their knees, or sit down on the floor below the screens. With this construction, Herregraven staged a contemporary version of a plot device used in classic theatre: the *deus ex machina*. This device is the sudden, unexpected appearance of an omnipotent and omniscient agent who intervened in a plot situation too complicated, intricate, or too hopeless to be able to be resolved by humans. The deity in question would appear out of nowhere, usually from above, and decide on the final outcome of the drama. The Latin phrase *deus ex machina* refers to the crane used in Greek (and Roman) theatre to stage this divine intervention. In Greek theatre, often one of the twelve Olympian Gods would appear to resolve the situation at hand. Arguably, this staging conjures up the notion of the necessity of an omnipotent non-human agent to reverse an algorithmic catastrophe. However, the reference to the device of the *deus ex machina* does more than facilitate acritique of algorithmic trading as a hopeless drama of our own making which requires divine potency to be resolved. Seen in light of Kierkegaard’s conception of faith, which holds that one must first fall to the ground in order to come out with a leap of faith, a different understanding emerges.

Figure 8: Exhibition view of *Pull everything, pull everything* by artist Femke Herregraven.

To live with faith is to believe in the possible when nothing seems possible. Living with faith involves being open the absurd. Faith rests on the absurd, Kierkegaard explains in *Fear and Trembling*. It is absurd as it requires believing in the possible against a backdrop of all the good reasons to doubt it. This tension can only be worked through by assuming possibility, and this happens by embracing the absurd. The absurd battles through doubt and reason. With his notion of having faith as being open to the absurd, Kierkegaard argues against the idea that the external world is subject to logic; not all that happens in the world can be explained by rationalizations and causal laws. With the staging of the *deus ex machina*, Herregraven alludes to a possibly absurd turn of events not determined by logic and reason which could never happen or follow from rational principles, but only by *suspending* one’s rational faculties. Doing so, she forges links between things that were previously unconnected: a *deus ex machina* and algorithmic trading. The *deus ex machina* points to a form of virtual presence *within* the actual, the regular, and the ordinary: a divine presence with the forceful and palpable powers to cause volatility and whirlwind beyond the ability of humans to manage and exploit stands in relation to algorithmic trading. The *deus ex machina* keeps the plot open to unexpected twists and turns — movement at the spot. It is about imagining openings in a seemingly closed system, to move beyond the financial sublime and open up to possibilities that exceed the expected and the probable, and that defy the seeming rectangle, rational and the causal spaces of algorithmic trading.

## The Possible in the Actual: Spectral Interventions in the Black Box of Finance

Where does this imaginary of specters and deities take us? *Fragments on Machines* and *Pull everything, pull everything* no longer believe that mapping, visualizing, or tinkering with algorithms might result in better managed, regulated, or stable financial markets. Instead, these works allude to possible endings and collapse of the state-backed algorithmic trading on the financial markets as the way forward. Combined, the specter of *Fragments on Machines* and the *deus ex machina* of *Pull everything, pull everything*, can be considered as artistic reminders of what Kierkegaard had in mind with his conception of the possible. Believing in the possible means believing all things are possible in actual and concrete existence, which happens ‘by virtue of the absurd’.[[91]](#footnote-91) Actual and concrete existence is not the sum of its parts, but is accessible to possibility. Believing in the possible it is to think transcendence *and* immanence at once. For Kierkegaard, possibility, actuality, and necessity cannot be reduced to one another and are not opposed to one another. Those who argue ‘everything is neoliberalism’ have been fooled by necessity — and those who argue capitalism is an ephemeral fluidity have been fooled by possibility. By drawing correlations between trading software and the catastrophes of nature and between hardware and the divine, more conventional assumptions about algorithmic trading are challenged. On the one hand, there is the finite, represented as the brick and mortar and technical infrastructure of algorithmic trading. On the other hand, there is infinite possibility.

It could be argued the spectral and phantom-like portrayals of *Fragments on Machines*, and *Pull everything, pull everything* is not so different from the aesthetic practices of digging down and standing back. Indeed, similar visual tropes are depicted. However, a significant difference is that algorithmic trading is not reduced to its finite infrastructures. Neither is the opacity of the infrastructure framed as both the problem and solution to black-box anxiety. Instead, their spectral imaginaries embed algorithmic trading in the larger context of risk culture and in the social and environmental aspects of that culture. It is situated between the broader context of a neoliberal culture of risks with its systemic logic of growth and accumulation *and* the possibility of spirited, radical, and absurd interventions in this culture.This possibility is indicated in *Fragments on Machines* by the flood, a spectral presence and by the suggestion of new beginnings. In *Pull everything, pull everything,* the *deus ex machina* refers to the possibility a sudden, forceful yet absurd plot twist. Possibility in the form of specters and deities and in the form of floods and catastrophes are an answer to black-box anxiety, to technological determinism, and neoliberal fatalism. They are an antidote to hopelessness. The figures of the specter and the *deus ex machina* open anxiety up to possibility. The specter and the *deus ex machina* are a form of artistic tactical resistance against a way of imagining automated capitalism and the algorithmic trading happening on its markets as an all-encompassing totality, as a regime that knows no ‘end’, no ‘alternatives’ and no ‘exits’ nor an ‘outside’, against a kind of thinking that asserts that everything that happens can have meaning only in relation to this totalizing frame.[[92]](#footnote-92)

The spectral imaginary expands the concept of the black box of finance by showing how it is temporal, vulnerable, malleable, and can be transformed by encounters. It is neither the algorithms nor the infrastructures that cause anxiety, but the experience of a lack of possibility. The possible, according to Kierkegaard, happens by virtue of the absurd. An absurdity marks the synthesis between faith and reason; it is an event that cannot be grasped by reason. Here, the prodigious flood, the hybrid and the specters in the back box of finance mark the gap between the human attempt to rule over the world *and* the unruliness of that world. The flood, the hybrid, and the spectral whirlwind in the trading room are reminders that algorithmic trading is subject to all possible forces in and of and beyond the world; its systems will run down, can break and be broken. With their critical reflections, Charles and Herregraven veer away from determinism and fatalism, away from totalizing frames. Their spectral interventions may help to imagine different openings, futures, endings, and new beginnings of automated capitalism. After all, and to refer to Murakami, imagination is the place for defeats and victories.

The next chapter explores the anxieties around web searches evoked by Google’s monopolist position of its search engine and the financialization of its search results. It discusses a series of prominent artworks that critically engage with Google’s search engine. One striking motif within these prominent artistic representations is the reframing of web searches as an act of collecting or the formation of a collection. Camille Henrot’s experimental film *Grosse Fatigue* (2013) will be analyzed in this regard. By reading *Grosse Fatigue* in tandem with Walter Benjamin’s concept of the collector and Kierkegaard’s conception of the possible as a passionate activity, this analysis brings passionate acts of possibility into view.

1. Parts of this chapter were published in P. de Vries, ‘Conjuring Spirits in the Black Box of Finance’, in *State Machines: Reflections and Actions at the Edge of Digital Citizenship, Finance, and Art*, edited by Y. Colakides, M. Garrett, and I. Gloerich, Amsterdam: Institute of Network Cultures, 2019; P. de Vries, ‘A Transformative Encounter with a Deity’, *CAC: Resurrecting Cybernetics*, 1, Shanghai, China: Chronus Art Center, 2019. [↑](#footnote-ref-1)
2. HFTs are proprietary trading firms that use high-speed systems to monitor market data and submit large numbers of orders to the markets. HFTs utilise quantitative and algorithmic methodologies to maximise the speed of their market access and trading strategies. Some HFTs are hybrids, acting as both proprietary traders and as market makers. In addition, some HFT strategies may take "delta-neutral" approaches to the market (ending each trading day in a flat position), while others are not delta-neutral and sometimes acquire net long and net short positions. High-frequency trading uses algorithms to automate quantities of trades. These algorithms are used to take advantage of small differences in price between bidding and selling prices across markets. HFT algorithms execute millions of trades in fractions of seconds. Part of the HFT algorithmic operations implemented in stock trading use modern programming languages. The more complex models, such as pattern recognition or predictive models are used to initiate trading. Some HFT algorithms are programmed to cease trading when a market gets too volatile when prices fluctuate heavily. Time is money on the stock exchange. Where for the stock market trader of yesteryear every second counted, nowadays a split-second makes the difference. In order to benefit from short-term price differences at various exchanges, traders use trading algorithms. Such algorithms are deployed to analyse terabytes of data from many data sources, such as unfolding news reports, market index trackers, live feeds of financial exchanges, newspapers, blogs and social media posts. They monitor movement in the stock exchanges and detect or execute pump-and-dump schedules. With various data sources a picture of the markets is formed, traders look for movements on the markets, hedge bets on how world events might affect prices on the markets, upon which decisions to trade are based, and in a billionth of a second trades in funds, bonds, equities, currencies, commodities and futures are made. Such speculative trading is, to an extent, future prediction: predicting the movement on the markets split seconds from now. The performance of algorithms is constantly monitored, honed and tweaked to changed market conditions and in an attempt to stay ahead of competitors. These developments further fired up the speed of trade deals from minutes, to seconds, to milliseconds, down to microseconds. SEC, ‘Report of the Staffs of the CFTC and SEC to the Joint Advisory Commission on Emerging Regulatory Issues’, *Washington D.C.: U.S. Security & Exchange Commission*, 30 September 2010, https://www.sec.gov/news/studies/2010/marketevents-report.pdf, 45. [↑](#footnote-ref-2)
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6. N. Popper and J. Anderson. ‘Trader Arrested in Manipulation that Contributed to 2010 “Flash Crash”’, *The New York Times*, 21 April 2015, https://www.nytimes.com/2015/04/22/business/dealbook/trader-in-britain-arrested-on-charges-of-manipulation-that-led-to-2010-flash-crash.html. [↑](#footnote-ref-6)
7. SEC, ‘Report of the Staffs of the CFTC and SEC to the Joint Advisory Commission on Emerging Regulatory Issues’, 7. [↑](#footnote-ref-7)
8. SEC, ‘Report of the Staffs of the CFTC and SEC to the Joint Advisory Commission on Emerging Regulatory Issues’, 79. [↑](#footnote-ref-8)
9. SEC, ‘Report of the Staffs of the CFTC and SEC to the Joint Advisory Commission on Emerging Regulatory Issues’, 79. [↑](#footnote-ref-9)
10. SEC, ‘Report of the Staffs of the CFTC and SEC to the Joint Advisory Commission on Emerging Regulatory Issues’, 17. [↑](#footnote-ref-10)
11. NANEX, ‘NANEX Flash Crash Summary Report’, 27 September 2010, http://www.nanex.net/FlashCrashFinal/FlashCrashSummary.html. Time is money on the stock exchange. Where for the stock market trader of every second counted, nowadays a split-second makes the difference. In order to benefit from short-term price differences at various exchanges, traders use trading algorithms. Trading firms use high-frequency trading algorithms (HFT) to monitor market data and submit large numbers of orders to the markets, and to maximize the speed of their market access and different trading strategies. HFT algorithms can execute millions of trades in fractions of seconds and are deployed to analyze terabytes of data from many data sources, such as unfolding news reports, market index trackers, live feeds of financial exchanges, newspapers, blogs and social media posts. With various data sources a picture of the markets is formed, traders look for movements on the markets, hedge bets on how world events might affect prices on the markets, upon which decisions to trade are based, and in a split-second trades in funds, bonds, equities, currencies, commodities and futures are made. Such speculative trading is, to an extent, future prediction: predicting the movement on the markets a fraction of a second from now. The performance of algorithms is constantly monitored, honed and tweaked to changed market conditions and in an attempt to stay ahead of competitors. [↑](#footnote-ref-11)
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25. Pasquale, *The Black Box Society*, 103. [↑](#footnote-ref-25)
26. Pasquale, *The Black Box Society*, 103. [↑](#footnote-ref-26)
27. Pasquale, *The Black Box Society*, 131. [↑](#footnote-ref-27)
28. Pasquale, *The Black Box Society*, 132. [↑](#footnote-ref-28)
29. Pasquale, *The Black Box Society*, 9. [↑](#footnote-ref-29)
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31. Hui, ‘Algorithmic Catastrophe’, 139. [↑](#footnote-ref-31)
32. Hui, ‘Algorithmic Catastrophe’, 140. [↑](#footnote-ref-32)
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36. E. Benjaminsen, ‘Where Money Is Made: Surfaces of Algorithmic Capital’, *Eline Benjaminsen*, 2017, http://www.elinebenjaminsen.com/. [↑](#footnote-ref-36)
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39. Green and Hopfengärtner, ‘75000 Futures’. [↑](#footnote-ref-39)
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41. Such as Alexandre Laumonier, Ingrid Burrington, Suzanne Treister, Timo Arnall, Serge Onnen, Zachary Formwalt, the artist-duo Beate Geissler and Oliver San, as well as Ryoji Ikeda, Simon Denny, to name but a few. [↑](#footnote-ref-41)
42. Bucher, *If… Then,* 43-44. [↑](#footnote-ref-42)
43. The concept of transparency has travelled across space and time, from its Latin roots (*transparere*), via the French Revolution and Rousseau, the American lawyer Louis Brandeis, and the German art historian Benjamin Buchloh, to the Australian director of WikiLeaks, Julian Assange. There is a wealth of critical literature on ‘transparency thinking’ challenging what Susan H. Williams dubbed Enlightenment Vision and deconstructing the power-knowledge nexus. E.g. Dean 2002; E. Sedgwick Kosofsky, ‘Paranoid Reading and Reparative Reading: Or, You’re so Paranoid You Probably Think This Essay is About You’, in *Touching Feeling: Affect, Pedagogy, Performativity*, Durham: Duke University Press, 2003; L. Lessig, ‘Against Transparency’, *The New Republic*, 9 October 2009, https://newrepublic.com/article/70097/against-transparency; C. Birchall, ‘Introduction to “Secrecy and Transparency”: The Politics of Opacity and Openness’, *Theory, Culture & Society*, 28.7–8 (2011): 7–25; B.C. Han, *The Transparency Society*, Redwood City: Stanford University Press, 2012; M. Fenster, ‘Transparency in Search of a Theory’, *European Journal of Social Theory*, 18.2 (2015): 150-167; P. de Vries, ‘Black Transparency in the Era of Post-Truth’, *Krisis*, 1 (2018): https://krisis.eu/black-transparency-in-the-era-of-post-truth/; Bucher, *If… Then*. [↑](#footnote-ref-43)
44. Another example is *Terraeconomics* (2016-2017), a speculative value system tied to the earth’s resources. With this installation piece, speculative designer Monique Grimord critiques the neoliberal agenda behind the Bloomberg trading system. She did so by building a supercomputer that logs bio-data of minerals, oils, metals, and other natural resources collected from oceans, forests, and the atmosphere. The computer reads the data it receives, and algorithms measure how the "health of the earth" is doing. Here, trading algorithms are imagined as technologies deployed to serve the financial interests of their "owners" and are reimagined to do similar work, but then in the interest of the agenda of the artist involved. [↑](#footnote-ref-44)
45. Felski, *The Limits of Critique,* 83. [↑](#footnote-ref-45)
46. Trading algorithms are named for marketing purposes. The names given to them are meant to persuade investors to make use of a specific algorithm. Their names are also an indication of the kind of trading strategy an algorithm is programmed to execute. Some trading algorithms are programmed to monitor and detect movement on the market. For example, when an order of shares is placed by an algorithm programmed to do so, rival algorithms, when programmed to do so, can buy or sell those same shares to either drive prices up or down. Patterson, *Dark Pools.* Other algorithms work to create and profit from movement by a strategy that is called layering. Layering is a tactic in which trading algorithms are programmed to place and then cancel a vast majority of the orders they make. These algorithmic orders-and-cancellations help traders to sell above the bid price in much less than a second. Others are programmed to monitor competitors without being noticed. The performance of these algorithms is constantly monitored, honed, and tweaked to changed market conditions and in an attempt to stay ahead of competitors. These developments automated the financial markets, fired up the speed of trade deals from minutes, to seconds, to milliseconds, down to microseconds. What is more, names such as Landmine, Power Tower, From Above, To the Moon, Blast This, City Under Siege, and Ambush are not only inherently aggressive, combative, predatory, and war-like, they also suggest a semblance of control—and confer phallocentric and anthropomorphic tendencies in the name-givers of trading algorithms. [↑](#footnote-ref-46)
47. Robin Hood Cooperative, ‘The Parasite’, *RHMAM*, 2017, https://www.robinhoodcoop.org/. [↑](#footnote-ref-47)
48. RYBN, ‘The Algorithmic Trading Freak Show’, installation, 2013, exhibited at *Transmediale*, Haus der Kulturen der Welt, Berlin, 2016. [↑](#footnote-ref-48)
49. L. Autogena and J. Portway, ‘The Planetarium’, *Black Shoals*, 2011, http://www.blackshoals.net/the-project-1/. [↑](#footnote-ref-49)
50. Autogena and Portway, ‘The Planetarium’. [↑](#footnote-ref-50)
51. Through hand drawn maps and charts, Suzanne Treister’s *HFT The Gardener* tells the story of the fictional figure Hillel Fischer Traumberg. Traumberg is an algorithmic high frequency trader who experiments with psychoactive drugs and studies the ethno-pharmacology psychoactive plants. He uses Hebrew numerology to merge the numerological equivalents of the botanical names of his psychoactive plants with companies listed in the *Financial Times’* Global 500 Index. And in the work of Fibbe’s live performance art *Diva’s Live,* trained classical singers vocalise the fluctuations of real time market data. Ben Thorp Brown’s *After Outcry* investigates the complex and absurd gestures that were once a primary mode of communication between commodities traders. [↑](#footnote-ref-51)
52. They rely on an understanding of the black box that is also found in the cybernetic theories of B. F. Skinner, for example. Akin to this, in *Technological Determinism is Dead: Long Live Technological Determinism* (2008), Sally Wyatt provides a typology of what she observes to be a continued and persistent technological determinism in Society and Technology Studies. Elements of the persistence of what she calls soft technological determinism can be found, amongst others, in the tendency to classify historical epochs and societies by their dominant technological artefacts — the ‘Black Box Society’ or the ‘Age of Algorithms’, for instance. S. Wyatt, ‘Technological Determinism is Dead: Long Live Technological Determinism’ in *The Handbook of Science and Technology Studies*, edited by E.J. Hacklett et al., Cambridge: The MIT Press, 2008, 168. [↑](#footnote-ref-52)
53. Felski, *The Limits of Critique,* 146. [↑](#footnote-ref-53)
54. See, for example, *Nervous Systems* (2016) at Haus der Kulturen der Welt in Berlin, Germany; *Globale: Global Control and Censorship* (2015/2016) ZKM, Karlsruhe, Germany; *Infosphere* (2017) at CENART in Mexico City, Mexico; *Mediated Architecture*, Swiss Architecture Museum, HeK (House of Electronic Arts Basel), Switzerland; *New Mythologies*,POSTmatter/Second Home, London, UK; and *I stood before the source*, The Blackwood Gallery, University of Toronto, Canada. [↑](#footnote-ref-54)
55. L. Daston and K. Park, *Wonders and the Order of Nature: 1150-1750*, New York, NY: Zone Books, 1998, 10. [↑](#footnote-ref-55)
56. Daston and Park, *Wonders and the Order of Nature,* 24. [↑](#footnote-ref-56)
57. Daston and Park, *Wonders and the Order of Nature,* 19. [↑](#footnote-ref-57)
58. Daston and Park, *Wonders and the Order of Nature,* 20. [↑](#footnote-ref-58)
59. Daston and Park, *Wonders and the Order of Nature,* 54. [↑](#footnote-ref-59)
60. Daston and Park, *Wonders and the Order of Nature,* 181. [↑](#footnote-ref-60)
61. Daston and Park, *Wonders and the Order of Nature,* 181. [↑](#footnote-ref-61)
62. Daston and Park, *Wonders and the Order of Nature,* 192. [↑](#footnote-ref-62)
63. Daston and Park, *Wonders and the Order of Nature,* 186. [↑](#footnote-ref-63)
64. K. Marx, *The Grundrisse: Foundations of the Critique of Political Economy*, London: Penguin Books, 1993. [↑](#footnote-ref-64)
65. Felski, *The Limits of Critique,* 158. [↑](#footnote-ref-65)
66. E. Peeren, *The Spectral Metaphor: Living Ghosts and the Agency of Invisibility,* London: Palgrave MacMillan, 2014, 10. [↑](#footnote-ref-66)
67. Peeren, *The Spectral Metaphor,* 10. [↑](#footnote-ref-67)
68. M. del Pilar Blanco and E. Peeren, *The Spectralities Reader: Ghost and Haunting in Contemporary Cultural Theory*, New York, NY: Bloomsbury, 2013, 9. [↑](#footnote-ref-68)
69. Del Pilar Blanco and Peeren, *The Spectralities Reader,* 8. [↑](#footnote-ref-69)
70. Del Pilar Blanco and Peeren, *The Spectralities Reader,* 8. [↑](#footnote-ref-70)
71. Del Pilar Blanco and Peeren, *The Spectralities Reader,* 10. [↑](#footnote-ref-71)
72. E.g. J. Vogl, *The Specter of Capital*, Cambridge: Stanford University Press, 2014. [↑](#footnote-ref-72)
73. M. Fisher, *The Weird and the Eerie*, London: Watkins Media, 2016, 11. [↑](#footnote-ref-73)
74. Fisher, *The Weird and the Eerie,* 11. [↑](#footnote-ref-74)
75. Fisher, *The Weird and the Eerie,* 11. [↑](#footnote-ref-75)
76. Fisher, *The Weird and the Eerie,* 13. [↑](#footnote-ref-76)
77. Fisher, *The Weird and the Eerie,* 11. [↑](#footnote-ref-77)
78. Buchanan, ‘Physics in Finance’. [↑](#footnote-ref-78)
79. Cooper, *Turbulent Worlds,* 175. [↑](#footnote-ref-79)
80. Cooper, *Turbulent Worlds,* 176. [↑](#footnote-ref-80)
81. Traders between 10-15 different algorithms working to exploit and produce information asymmetries, including bots that monitor the market. On their screens, traders look at visualisation of indications of movement on the market, reduced and simplified to fit a set of screens filled with graphs, charts, and flows. The market becomes a non-spatial abstraction on a screen. [↑](#footnote-ref-81)
82. Daston and Park, *Wonders and the Order of Nature,* 90. [↑](#footnote-ref-82)
83. Daston and Park, *Wonders and the Order of Nature,* 114. [↑](#footnote-ref-83)
84. Daston and Park, *Wonders and the Order of Nature,* 57. [↑](#footnote-ref-84)
85. Kierkegaard, *The Concept of Anxiety,* 71. [↑](#footnote-ref-85)
86. Bier and Schinkel, ‘Building Better Ecological Machines’, 285. [↑](#footnote-ref-86)
87. MacKenzie, *Cutting Code*, 166. [↑](#footnote-ref-87)
88. MacKenzie, *Cutting Code*, 166. [↑](#footnote-ref-88)
89. D. Fox, ‘Concerning Technology’, *Review 31*, 2018, http://review31.co.uk/essay/view/61/concerning-technology. [↑](#footnote-ref-89)
90. K. Scepanski, ‘Femke Herregraven's First Institutional Solo Exhibition on View at Westfälischer Kunstverein’, *Art Daily*, 2018, http://artdaily.com/news/106830/Femke-Herregraven-s-first-institutional-solo-exhibition-on-view-at-Westf-auml-lischer-Kunstverein. [↑](#footnote-ref-90)
91. Kierkegaard, *Fear and Trembling,* 46. [↑](#footnote-ref-91)
92. V. Kal, *Levinas en Rozenzweig*, Zoetermeer: Uitgeverij Meinema, 1999, 153. [↑](#footnote-ref-92)