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Roberto Filoseta

## Electronic Dance Music in Narrative Film

### Abstract

As a growing number of filmmakers are moving away from the traditional model of orchestral underscoring in favor of a more contemporary approach to film sound, electronic dance music (EDM) is playing an increasingly important role in current soundtrack practice. With a focus on two specific examples, Tom Tykwer's *Run Lola Run* (1998) and Darren Aronofsky's *Pi* (1998), this essay discusses the possibilities that such a distinctive aesthetics brings to filmmaking, especially with regard to audiovisual rhythm and sonic integration.

**Keywords:** soundtrack; sound design; film music; film rhythm; audiovisual rhythm; electronic dance music; electronica; techno; glitch.

# 1 — Introduction

Electronic dance music (EDM) is the latest addition to the sonic resources of narrative film. As a loose umbrella term, EDM refers to a form of popular music that owes its existence to recent developments in electronic sound production technologies, its aesthetics tightly bound up with the tools, procedures and processes on which it relies heavily for its realization. It includes the more common styles of house, techno, drum ‘n’ bass, and trance, as well as a plethora of other genres and subgenres which, confusingly, are not necessarily conceived for dancing (see McLeod 2001; Butler 2003/2006). Nevertheless, as the focus of this writing is largely on audiovisual rhythm, I discuss EDM as a genre specifically concerned, at its core, with beat-driven, groove-based sonic structures.<sup>1</sup>

Some authors use the term “electronica” to refer to the same musical territory. But other authors (McLeod 2001; Butler 2003/2006) have pointed out that the “electronica” label, used as a catchall term, is in effect a marketing gimmick popularized in the 1990s by the music industry. In its more current sense, instead, the term electronica denotes a genre *within* the EDM umbrella where, confusingly, it may indicate either a beatless style, or it may refer to the earlier electronic productions of the 70s and early 80s, sometimes also called “synth-electronica.” These latter are characterized by luscious synthesizer parts articulating more conventional melodic and harmonic material, with less emphasis (and often less sophistication) on the rhythmic elements. Examples of (synth-)electronica in film include John Carpenter’s *Assault on Precinct 13* (1976), Alan Parker’s *Midnight Express* (1978), and Ridley Scott’s *Blade Runner* (1982), among others. These films represented something of an exception in an industry dominated by the conventional orchestral scoring practice. But by the late 1990s a surge can be observed in the number of films featuring EDM in their soundtracks.

Certainly, technological developments have played a role in this phenomenon — the surge coincides with the transition from analogue to digital technologies across audio and video production processes, which brought unprecedented ease to the manipulation and structuring of audio and visual material. By that time, EDM had reached the status of a mature and recognized field, encompassing a rich variety of stylistic approaches and a growing number of practitioners and audiences. But none of those factors, in themselves, could have started the trend if there had not been, fundamentally, a genuine search for an alternative language eschewing the worn devices of orchestral underscoring. As Danijela Kulezic-Wilson remarks, “Cinema overexploitation of conventional scoring practices has reached the point when music’s impact in film is either devalued by its overuse, or can produce an effect opposite of that desired, especially when employed with the intention of augmenting audiences’ affective

responses” (Kulezic-Wilson 2017, p. 134). The language of cinema itself has evolved considerably, and the conventional approach to the soundtrack is becoming inadequate to the needs of contemporary filmmaking. Thus, we see a growing number of directors looking at alternative models, and the structures of EDM have a significant role to play in this search.

All this is good news for the electronic composer/producer. But what does EDM have to offer specifically to narrative film? What are its distinctive features, and how are these deployed by filmmakers to construct more dynamic and better integrated audiovisual structures? To answer those questions, in this essay I will first provide a concise account of EDM’s main features, followed by a short section reviewing the fundamentals of film rhythm and its relation to music rhythm. I will then proceed to illustrate how EDM can function in narrative cinema, focusing on two films that can be regarded as seminal works in this trend: Tom Tykwer’s *Run Lola Run* (1998), and Darren Aronofsky’s *Pi* (1998). These films have been selected for their remarkably integrated use of EDM in their structures.

To clarify this further, I start by distinguishing between two broad lines of films. On one line we have works that are in some way *about* EDM cultures. In such films EDM is, predictably, what we expect to hear, given their specific focus on characterizing the club “scene,” the DJs, the rave, and the associated sex and drugs narratives. Danny Boyle’s *Trainspotting* (1996) was perhaps the initiator in this trend, soon to be followed by a few other worthy successors like Justin Kerrigan’s *Human Traffic* (1999), Doug Liman’s *Go* (1999), and Hannes Stöhr’s *Berlin Calling* (2008), to name but a few. In an article comparing *Run Lola Run* and *Berlin Calling*, Sean Nye places the latter within a “tradition of *techno scene film*” (Nye 2010, emphasis in original), stating that “This type thus acts like a sociological study of club scenes in film form” (Nye 2010, p. 122). These films will *necessarily* include EDM to construct a specific diegetic reality reproducing “real life” experience. At their best, they may exhibit an integrated use of EDM, and would very much deserve detailed analysis. But my aim in this essay is to tease out what EDM has to offer to narrative film in general, as a deliberate stylistic choice alternative to more conventional orchestral scoring, not dictated by diegetic necessity.

This brings us to the second line of films — works that are not so specifically focused on narrating the EDM world as such. Many soundtracks of the past three decades include elements of EDM as a deliberate choice, but it is difficult to find works that achieve the degree of stylistic consistency observable in *Run Lola Run* and *Pi*. Instead, it is more common to find EDM used within or alongside more conventional orchestral parts. In films like *The Matrix* (Wachowski Brothers 1999), and *Lara Croft: Tomb Raider* (Simon West 2001), for

example, the EDM elements are overwhelmed by some less imaginative orchestral material of an epic quality. As Mark Minett puts it, “Revell’s work on *Tomb Raider* can be seen as typical of the bombastic Hollywood blockbuster approach to EDM” (Minett 2013).

Similarly for films like *The Saint* (Phillip Noyce 1997), *The Beach* (Danny Boyle 2000), *Spy Game* (Tony Scott 2001), *Man on Fire* (Tony Scott 2004), *Layer Cake* (Matthew Vaughn 2004), *The Sentinel* (Clark Johnson 2006), and many others. There are, no doubt, many interesting aspects to these films’ soundtracks, some remarkable cues and a sophisticated use of sound design; but ultimately, the inclusion of some interjected or intermixed EDM elements does not change the fact that these works remain very much rooted in more conventional scoring practice, featuring well-established orchestral gestures that range from epic to clichéd sentimental.

Much more stylistically consistent, instead, are films like *Sexy Beast* (Jonathan Glazer 2000), and *Amores Perros* (Alejandro González Iñárritu 2000). These films, too, include both EDM and non-EDM music as part of their soundtracks, but they neatly avoid falling on the conventional orchestral model, resorting instead to other forms of popular musics for their non-EDM cues. And finally we have films like *Fight Club* (David Fincher 1999) and *Hanna* (Joe Wright 2011), which have entirely EDM-based soundtracks (though *Hanna* does include some narratively relevant North African diegetic music), remarkably integrated with elaborate sound design.

*Run Lola Run* and *Pi* are part of this latter group,<sup>2</sup> and remain prime examples of a more radical use of EDM in film. As will be shown in their respective analyses, these films do not simply employ some EDM as part of their soundtrack; their audiovisual strategy consistently exploit specific formal features of EDM, particularly its rhythmic structures and its distinctive sound quality, for specific narrative ends. They therefore offer a particularly rich terrain for analysis in the context of this writing.

## 2 — Electronic Dance Music: Main Features

Rhythm is the essence and main principle of organization in EDM, the parameter on which all other parameters depend. Unlike other styles of popular music, in which the drums function mainly in a supporting role to melody, harmony and vocals, in EDM the percussive elements are literally foregrounded, dominating both the mix and the musical discourse. Melodic lines or vocal parts (when present) are themselves mostly structured as looped patterns contributing

to the articulation of rhythmic relationships (except for some drones and pads filling the texture). The bass frequencies are particularly emphasized; the role of the bass drum and bass line is primary in establishing the music's pulse.

Vijay Iyer stresses "EDM's connections to musics of the African diaspora" (Iyer 2008). And indeed in EDM the logic of African percussion music can be seen in the way in which several short repeating patterns, individually simple, combine to create complexity at the higher structural level. Nevertheless, the electronic nature of EDM's production processes takes groove-based music to a new terrain, with its own distinct aesthetics and potentialities, as well as challenges. In terms of its rhythmic structures, for example, electronic music production offers two compositional possibilities specific to studio realization: the first is the possibility of structuring events on a consistent, machine-accurate alignment of beat and chronometric time; and indeed EDM practitioners do make regular use of the "quantize" function offered by sequencers (at least for some of the music's layers). The second possibility lies at the opposite end of the spectrum: creating irregular patterns, independent lines of non-aligned rhythm, loops that produce metrical ambiguity, go in and out of phase, etc. — but even this device can only function (can only be "out") in *relation* to a strictly regulated beat structure.<sup>3</sup>

Regular, cyclic repetition and a strong sense of meter are the fundamental characteristics of EDM as a "dance" music.<sup>4</sup> This does not mean that EDM cannot articulate sophisticated relationships; Mark J. Butler (2003/2006), in particular, has written extensively to highlight EDM's rhythmic complexities and ambiguities. But all such nuances occur within a well-defined, predictable temporal framework; as he states: "Though individual rhythms within the network tend to be highly syncopated, as a whole they usually express the meter clearly" (Butler 2003, p. 103). This *has* to be the case if EDM is to perform its intended communal function; predictability in the music's timing and structure is essential to free-form, non-codified dancing, as dancers have to coordinate their movements in *anticipation* of the beat. The notion of "anticipation" points to the listener's active role in the construal of meter. Recent studies in the psychology of perception usefully conceptualize the perception of rhythmic structures as "an interaction between what is heard ("rhythm") and the brain's anticipatory structuring of music ("meter")" (Vuust and Witek 2014). In other words, meter is *inferred* by the listener; it is the pulse *implied* by a certain rhythm, but the pulse itself may or may not be marked by aural events. The "four-on-the-floor" bass-drum pattern found in techno, for example, articulates the meter fully — rhythm and meter coincide; whereas in "breakbeat"-based genres like jungle or drum 'n' bass the bass-drum pattern does not fully duplicate the meter: some of the beats are omitted or displaced to the off-beats (except for the obligatory downbeat at the beginning of each bar).

Within this logic of cyclical repetition, forward movement is generated by a process of addition and subtraction whereby several interacting rhythmic layers, constituted by loops of differing lengths, are brought in and out at specific points, typically marking musical statements lasting some multiple of four bars. As Butler explains, “EDM’s structure is modular, consisting of relatively generic patterns that can be combined both vertically and horizontally in seemingly endless ways” (Butler 2003, p. 70). Such a modular approach results in an open form, lacking the kind of development that characterizes, for example, the Western music canon, and displaying, instead, a circular conception of musical time.

This ability to articulate both forward drive and stasis makes EDM an attractive option as a film soundtrack, where it can function to inflect the temporal perception of the action and narrative. It is true that similar rhythmic structures can also be found in other groove-based musics, e.g., Afro, Latin, samba, funk, etc., but there are other features that set EDM apart from its musical siblings. One of these was already pointed out above: EDM reliance on studio tools and techniques for its realization, which enables precisely controlled relationships between sound events and timeline in ways beyond the capabilities of human performance. I will now highlight a few other aspects that make EDM a distinctive option as film music.

EDM is further characterized by its particular *sound*, either constructed through electronic synthesis, or derived from acoustic sources recorded and manipulated into individual sound-qualities. The characteristic timbres of EDM often include much noise-based material, resulting in musical parts that integrate better with a film’s sound design and foley, or even function as sound design, or cross between music and sound design roles — these latter possibilities, in particular, represent a fertile trend in recent soundtrack practice.

Given its predominantly percussive and noise-based nature, EDM relegates pitch-based material to a secondary role, often reduced to not much more than a fundamental drone. When a harmonic universe can be detected at all, it tends to be based on modal relationships, and mostly on minor modes (Dorian, Aeolian, Phrygian); this modal character further accounts for the non-developmental quality of EDM. An alternative approach to the analysis of EDM’s tonality is given by Rene Wooller and Andrew Brown (2008), who question the applicability of concepts from traditional musicology, and propose instead four “descriptive continuums” (Wooller and Brown 2008). These are identified as: Rate of Tonal Change, Tonal Stability, Pitch/Noise Ratio, and Number of Independent Pitched Streams. The authors’ findings for Rate of Tonal Change in EDM confirm my assessment above of a low rate in general: “Overall, EDM is skewed more towards the “drone” end of the spectrum” (Wooller and

Brown 2008). The values for Tonal Stability, as “an estimate of how strong the sense of tonality (as tonicity) is” (Wooller and Brown 2008), were found to be in mid-range, reflecting a broadly modal language and a prevalence of minor modes, to which the authors add the Mixolydian as the next likely structure: “in the vast majority of cases, there is a clear tonic, regular scales are used; most commonly pentatonic minor, followed by minor and Mixolydian” (Wooller and Brown 2008). Pitch/Noise Ratio was again found to be in mid-range, though, the authors add, “varying substantially between sub-genres and individual tracks (Wooller and Brown 2008). The Number of Independent Pitched Streams, essentially the relative density of a texture in terms of pitched voices, or the degree of polyphony, was found to be in mid-range, though again with frequent deviations.

In terms of vocals, many tracks dispense with them altogether. When vocals are present, EDM tends to avoid sung lyrics; the voice is mostly used to articulate spoken lines, or wordless sound; both are often manipulated and integrated within the textural design (rather than foregrounded as is the case in conventional song structures).

Finally we need to consider EDM’s distinctiveness in its functioning as a cultural code when inserted in narrative film. Its electronic nature may connote the synthetic, the technological, the industrial. Its roots in youth culture may connote the urban, the hip, the rebellious. As a dance music, EDM may connote body rhythm, physical energy, sexual drive. As a club music, it may connote rave culture, drug taking, excess, abuse, sexual over-drive, and so on. Robynn Stilwell offers a more colorful expression to characterize the cultural connotations of techno soundtracks, stating: “films that choose hard-core techno have already constructed a certain “badassness” into the film” (Editors, The 2003). Nevertheless, these are only potentialities that need to be activated by a specific narrative context; they should not be intended as handy tokens for signaling unequivocally any simple meaning. Effective narration relies on complex contextual and transtextual relations that cannot be generalized.

Interestingly, despite the many possible associations highlighted above, EDM seems to lack a connection to a specific geographical area. As Caryl Flinn notes, “Techno paradoxically is grounded to region and place — for example, local rave cultures, clubs, and genres of techno of various cities — at the same time that it evades or evacuates geographical specificity” (Flinn 2004, p. 201). This is another reason why a filmmaker might choose EDM over other groove-based musics: in order to avoid too specific geo-cultural references that may not be appropriate to a certain narrative situation.



### 3 — Rhythm in Relation to Audio and Visuals

The idea of applying a musical logic to the structuring of film rhythm arises very early in the history of cinema. Writing in 1925, historian and critic Léon Moussinac remarked: “If we attempt to study cinegraphic rhythm, we can see that it has an obvious counterpart in musical rhythm” (cited in Mitry 1997, p. 111). As early as 1915, with *The Birth of a Nation*, Griffith was already cutting his films to create defined rhythmic patterns in the image track, soon to be followed by Abel Gance with *La Roue* (1922). Such techniques were eventually theorized and further refined by the directors of the Soviet Formalist school, Lev Kuleshov, Dziga Vertov, Vsevolod Pudovkin, and Eisenstein, among others. The term “montage” (from the French, *to assemble*) was adopted to indicate a particular way of cutting and splicing film material, an approach not bound by the rules of “continuity editing” typical of classical filmmaking, which relies on devices like cutting on action, eyeline match, and 180-degree staging to disguise the cinematic artifice and preserve the diegetic illusion. Discontinuity of action, time and space may, instead, be deliberately emphasized. In fact, montage is more than merely an editing technique — it is a sophisticated principle concerned with juxtaposing shots in ways that, by collision and interaction, generate an idea in the mind of the perceiver. In *Strike* (1925), for example, Eisenstein intercuts shots of soldiers firing at the defenseless workers with nondiegetic shots of a bull being slaughtered.<sup>5</sup>

As a technique of editing focused on shot-to-shot relations, montage privileges rapid cutting of film material, and this makes it particularly amenable to rhythmic patterning, a strategy that Eisenstein pursued consistently in the celebrated Odessa Steps sequence in *Battleship Potemkin* (1925). When sound was finally introduced in the late 1920s, Eisenstein simply expanded his earlier typology of montage methods, since these were already largely based on musical analogies, and theorized five main versions of *vertical* montage: metric, rhythmic, melodic, tonal, and overtone. Especially relevant to this discussion are the metric and rhythmic versions of vertical montage. Metric montage is simply matching shot lengths to specific musical features, e.g. beats, bars, phrases, and so on. Rhythmic montage, however, is more complex, as it takes into account what goes on within shots. To appreciate exactly what is involved, we need to examine how the notion of rhythm applies to music and to film.

In music, rhythm and meter are well defined and objectively measurable parameters; we can safely identify pulse, calculate tempo as beats per minute, determine groupings, and so on. But film rhythm is a much more complex notion. Rhythm in film is generated at three levels, often operating simultaneously: a) *editing* rhythm (or *cutting* rhythm), i.e., the rate at which the individual shots succeed each other; b) *figure movement*, i.e., the movement of the objects

and characters represented within a shot; and c) *camera movement*, i.e., panning, tracking, craning, zooming, etc. Of those three levels, editing rhythm is the only chronometrically measurable parameter; it is therefore no surprise that most of the experimentation with film rhythm since the beginning of cinema has concentrated on specifying mathematical relationships in the cutting of film material. But while it is indeed true that, as Jean Mitry observed, “film rhythm is experienced primarily by virtue of the effect of editing” (Mitry 1997, p. 125), it does not follow that shot durations could be organized into a visual rhythm in the same way that sounds can be organized into musical rhythm. To begin with, the ability of our visual perception in detecting shot length with the required degree of accuracy is questionable; as Mitry noted, “Obviously the audience is aware more or less of relationships of time but is incapable of evaluating *in any precise way* their metrical value” (Mitry 1997, p. 149, emphasis in original). Further, and more importantly, “rhythm is not made up of simple relationships of duration [...] Rhythm has more to do with *relationships of intensity*” (Mitry 1997, p. 125, emphasis in original), themselves contained within relationships of duration. “Intensity” results from the interaction of virtually an infinite number of variables at work in a particular shot: framing (closeup, long shot, etc.), lighting, camera angle, figure movement, camera movement, and so on — all these variables affect the perception of intensity in a shot. Furthermore, intensity is a relative concept. A shot does not so much possess, of its own, a certain degree of intensity; the shot acquires its intensity from its relationship to the preceding and following shot, as well as from its role within the whole narrative context. Thus, as a simplified example, a closeup may be perceived as an accent when presented after a series of long shots, whereas the same shot would not necessarily function as an accent when appearing among a series of closeups. Intensity, in its various degrees, affects our perception of shot duration. As Kulezic-Wilson notes, “Depending on the content, composition, framing, camera movement of the shot and its ‘density’, two shots of the same length might be perceived as being different in duration” (Kulezic-Wilson 2015, p. 38). That is why the notion of structuring visual rhythm merely by calculating shot length is fallacious.

However, it is at this point that the properties of sound can be harnessed to assist the task of structuring film rhythm. One of the fundamental functions of sound in film can be seen in its ability to temporalize the images. Of music, in particular, Mitry observed that “*it provides the visual impressions with the missing time content by giving them the powers of perceptible rhythm*” (Mitry 1997, p. 265, emphasis in original). It is by effectively deploying the temporalizing function of music that any metric and rhythmic organization of visuals become finally perceivable as such. At this point, the possibilities of creating and controlling *audiovisual* rhythm open up to the filmmaker. With regard to the specific rhythms of EDM, we will see how a repetitive pattern on the soundtrack can provide a reference beat against

which the complex visual rhythms could be related and understood. The next sections examine how these possibilities are effectively exploited by the directors of the films analyzed in this essay.

## 4 — Techno and Kinesis in Tom Tykwer's *Run Lola Run*

Tom Tykwer's *Run Lola Run* (1998) offers a particularly good example of the potentiality of EDM in the structuring of audiovisual rhythm for kinetic effect. In its exuberant visual style, *Lola* epitomizes David Bordwell's concept of "intensified continuity" (Bordwell 2002a). Bordwell rejects the notion that cinema has entered a "post-classical" phase in the 1960s, maintaining instead that, while much of contemporary filmmaking (post 1960s) has tended to emphasize certain techniques to extremes, the fundamental principles of classical continuity have continued to remain the backbone of mainstream (and some non-mainstream) filmmaking. Four main devices are identified as salient marks of intensified continuity: "rapid editing, bipolar extremes of lens lengths, a reliance on close shots, and wide-ranging camera movements" (Bordwell 2006, p. 121). All these techniques have a direct impact on film rhythm: cutting rate and camera movement affect meter, speed, and flow, while extremes in framing and lens lengths produce a range of intensities and accents that can be structured into defined patterns by means of editing. They are therefore ideal for creating highly kinetic audiovisual structures, and *Lola* exploits such techniques consistently to that end.

The film is organized as a forking-path plot (Bordwell 2002b): the same scenario is re-proposed three times, each time developed with slight but significant variations in the sequence of events, each leading to a different outcome. Lola has twenty minutes to find 100,000 marks and rescue her boyfriend Manni who, having lost a bag containing payment from a dodgy deal, fears he is going to be killed once the gang's boss turns up at the agreed time — twenty minutes from the time of his desperate call from a phone booth to Lola. This reversal of conventional roles, in which the female is cast as the lead character saving the powerless male companion, has prompted a persistent reading of the film in terms of gender relations, though writers differ in their assessment of the film's effectiveness in challenging stereotypical values. While Maree Macmillan, for example, considers *Run Lola Run* as "perhaps one of the first examples of a new breed of truly post-modern explorations of Woman" (MacMillan 2009), Ingeborg O'Sickey sees Lola as a "deflated heroine" (O'Sickey 2002).

As the title promises, a significant amount of footage is devoted to portraying Lola dashing through the streets of Berlin. These sections are characterized by extended montage sequences, and feature a nondiegetic techno soundtrack mixed in the foreground; diegetic sound is largely suppressed, except for rare occurrences in which selected ambient sounds are themselves integrated into the musical-sonic discourse. This techno music acts as a “main theme” to the film, with its driving pulse lending physical substance to the urgency of the action, and providing a perceptible time grid over which the narratively significant manipulations of the visual/narrative flow can be measured. As Mitry observed, “The time experienced by the characters in the drama [...] may be perfectly well recognized — but it is *understood*, not *experienced*. Film needed a kind of rhythmic beat to enable the audience to measure internally the psychological time of the drama, relating it to the basic sensation of real time (Mitry 1997, p. 248, emphases in original). Not only does this music supply the chronometric reference that enables the audience actually to *experience* — not just *understand*, at the intellectual level — the pressure of the clock ticking inexorably towards the deadline while the protagonists are trying to avert disaster; as a “dance” music, techno has the effect of translating the kinesis of the fast-paced images into the kinesthetic — the visceral sensation of movement itself, felt by the audience at the physical level, thanks also to the emphasis on bass frequency content from the prominent kick drum. This view is supported by the work of psychomusicologist Paul Fraisse, who wrote: “When a piece of music contains recurring isochronous patterns of strong, i.e., stressed, beats, it gives rise to a *motor* activity which develops in synchronization with the strong beats of a musical performance” (cited in Mitry 1997, p. 274, emphasis in original). In essence, this strategy is aimed at fostering character empathy by stimulating in the audience the psychological pressure of time passing and the dynamic sensation of a motor activity. Thus, rather than merely *witness* the protagonists’ ordeal, the audience can actually *experience* their mental and physical strain.

A few writers have remarked on the “musicality” of *Run Lola Run*, referring to the way its audiovisual strategy exploits particular features of its techno soundtrack. In this vein, Katherine Spring (2010) has highlighted sections of the film characterized by congruency in the accent structure across audio and visual channels. In her analysis, Spring draws from Marshall and Cohen’s (1998) Congruence-Associationist model, which focuses on the relationship between audio and visual accents to measure audience responses to audiovisual composites. Simply put, the model predicts that “the greater temporal congruence the greater the focus of visual attention to which the meaning of the music consequently can be ascribed” (Bolivar, Cohen and Fentress 1994).

It is clear that the regular structures of EDM provide ample scope for organizing audiovisual material into rational patterns implying a “musical” logic. However, I am concerned that an overemphasis on structural congruence may perpetuate a view of EDM as only good for “MTV-style” filmmaking,<sup>6</sup> which would not do any justice to either of the two films analyzed in this writing. Besides, the effectiveness of temporal audiovisual congruency should not be taken for granted. Marshall and Cohen’s original study (1998) relied on very basic animated graphics. But as Scott D. Lipscomb reports, “as the stimuli become more complex, the importance of accent structure alignment appears to diminish” (Lipscomb 1999). Lipscomb conducted a study comparing audience responses to three conditions of temporal alignment between audio and visual accents: *consonant*, *out-of-phase*, and *dissonant*. The experiment involved two sets of audiovisual composites: animation and motion picture excerpts, and found that, in contrast to ratings for animations, “in actual motion picture excerpts, subject ratings of effectiveness are no longer consistently highest for consonant alignment conditions and lowest for dissonant alignment conditions” (Lipscomb 1999). In this essay, therefore, I intend to go beyond the obvious instances of structural congruency, and show that EDM can offer a wider range of possibilities for meaningful audiovisual alignment. In effect, a strategy too reliant on congruency of audiovisual accents would soon become obtrusive, and while this may be exploited as a deliberate effect, it would soon defeat its purpose if overused. Indeed, even in a film like *Lola*, which revels in overt narration, we find that metrically organized audiovisual structures are limited to selected moments.

To understand *Lola*’s musical strategy it is necessary to look at how the film conceptualizes time; instances of audiovisual congruency need to be seen in relation to the overall strategy of temporal organization. As Caracciolo puts it, “*Run Lola Run* is a film obsessed with time, not only diegetically, because of the twenty-minute time window Lola has to reach her boyfriend, but also thematically” (Caracciolo 2014, p. 65). Being simultaneously *subject* and *object*, time, in *Run Lola Run* is purposefully manipulated at several interacting levels. Michael Wedel (2009) offers a good analysis of such levels, which span the whole spectrum from the macro-interval, i.e., the film itself, with its cyclical macro-structure, to the micro-interval: the flashforwards of still frames as the smallest unit of cinematic time. As Wedel observes, “In between those two extremes the kinetic experience of *Run Lola Run* can be reconsidered to unfold by a permanent modulation, alternation, and interference of different speeds and frequencies” (Wedel 2009, p. 140). In other words, moments of strict audiovisual temporal congruency are just one mode of synchronization among several at work in the film. They function as one stage on the continuum of possible time relationships and time representations, but the overall synchronization strategy in *Lola* is far more complex and the audio-to-visual relationship, overall, is not reducible to a *conformance* model<sup>7</sup> (cf. Spring 2010).

Take, for example, the segment starting at 00.25.20, the climactic moment when Lola, in her first life, is about to reach Manni at the meeting spot. The screen splits in the middle; we see Manni on the left half and Lola on the right, in different spaces. Over the steady four-on-the-floor time reference of the techno track, playing at full volume and with all diegetic sound suppressed, the images articulate contrasting speeds and tempi. On the left half we have slowed down footage, but even here there is a contrast between the rhythm of the busy shoppers coming and going in the background and the almost immobility of Manni in the foreground. On the other half of the screen we have a tracking shot, involving two independent speeds of figure and camera movement, showing Lola's running action in slow motion, while the wall behind her seems to move at an accelerated speed (a combined effect of tracking, soft focus, and closeup framing). There is hardly any cutting from 00.25.20 to 00.26.00 (only two barely perceptible cuts in Lola's half screen); it is practically all *internal* rhythm (figure and camera movement); nothing is synchronized to the music's beat. As the philosopher Henri Lefebvre noted, "we know that a rhythm is slow or lively only in relation to other rhythms" (cited in Wedel 2009, p. 139). And indeed this sequence capitalizes on Lefebvre's observation by having four different speeds on the image track (actually five, once the clock face appears in the lower part of the screen) playing over the steady pulse of the techno track, this latter functioning as the central time reference against which the visual rhythms can be related and understood. We could appreciate this sequence for its formal design, but there is more to it: this strategy is narratively significant. The juxtaposition of isochronous pulse and multiple speeds in the images reflects the tension between chronometric time and experienced time. The driving beat emphasizes, by contrast, the slower speed in the footage; the synergetic result is stillness and great kinetic energy simultaneously: Lola runs; Manni waits; the clock ticks away indifferent and unstoppable. The suppressed diegetic sound is a cue for subjectivity: against the objective time marked by the music's steady pulse, the protagonists' state of mind is evoked as the subjective experiencing of a warped temporal dimension — the interminable strain of "the last minute," the dilated time-space of "the last mile," the desperate yearning for a "last chance."

I suggest that a significant portion of *Lola* is characterized by *this* type of audiovisual relationships, this more sophisticated concept of "musicality." Complexity, multiplicity, and simultaneity are integral to this film's fundamental preoccupation with time and chance, and it is precisely by contrast with the asynchronous elements that instances of audiovisual structural congruency gain their meaning as "encounter," or convergence.

So far I have been characterizing the music in the “running” sequences as techno music; it is now time to refine my account of it. A relatively minor change occurs in the first part of the second run: the four-on-the-floor pattern of the bass drum is replaced by a sparser and constantly varied pattern emphasizing the off-beats, while the snare drum and electric guitar articulate a jungle/breakbeat pattern that foregrounds the pulse of the sixteenth notes. By having this round begin with an alternative version of the music, the film makes room for the meaningful return of the four-on-the-floor pattern. This is reintroduced when Lola enters her father’s bank (00.38.10), and by the time Lola marches her father at gunpoint to the cash office there is indeed a strong sense of synchrony between Lola’s pacing and the bass drum pattern (accent structure alignment). This device effectively functions to signify Lola’s chilling determination in carrying out a crazy act, as the building is monitored and soon to be surrounded by police: the stomping walk, expressed as a pounding bass drum, tells that Lola, with that gun in her hand, means “business.”

The third iteration (00.52.46) starts with a jungle/breakbeat pattern (revealed at 00.53.39), similar to the beginning of the previous run. But by 01.00.00 we find a significant change of style with the start of a new music cue (separated by 24 seconds of musical silence from the previous cue). This music follows the same groove-based logic of the previous cues, but it is neither techno nor electronic-sounding — at least not in the rhythm section; there may be synthetic drones and processes, but the overall sound quality is mainly acoustic. Ethnic-sounding drums articulate an Afro-inspired pattern, combined with flute-sound and wordless vocals delivering Indian-flavored lines at selected points. Here the acoustic timbres seem to suggest a more “organic” and humanized diegetic time-space, as opposed to the more synthetic and mechanized universe of the techno sections. This change of music style marks a significant turning point in the narrative. The cue starts when Manni spots the tramp who has got his money — this is the beginning of a turn of luck for Lola and Manni. From then on, fate will be kinder to the couple: Manni chases the tramp and recovers his money; Lola goes on to a spectacular win at the casino.

With regard to its rhythmic structure, this music functions in the same way as the previous techno: to provide a temporal reference by its regular pulse against which the rhythms of the images and narrative can be related and felt. A good example of effective design in the audiovisual rhythm can be seen between 01.00.52 and 01.01.45. These 53 seconds are composed of only two shots: the first approximately 15 seconds long, and the second approximately 38, joined by a soft crossfade; editing rhythm is therefore totally absent from this sequence — it is all figure and camera movement. All diegetic sound is suppressed. In relation to the steady pulse of the Afro drums, the bouncy rhythm of the running Lola

gradually shifts from out of phase at the beginning to a strong sense of audiovisual synchrony around the sequence's mid point, and gradually out again. The effect is emphasized by framing, which becomes gradually narrower until Lola's face is shown in extreme-closeup. The image background adds a third independent line of rhythm, appearing to speed up as it gradually goes out of focus. In sequences such as these, audiovisual relationships are articulated dynamically, and can only be understood in their diachronic unfolding, as a complex gesture cutting across all stages of the *conformance-complementation-contest* continuum.<sup>8</sup> In terms of narrative function, this is another moment of extreme subjectivity; we hear Lola's voice-over saying, "what shall I do? ... help me, please ... I'm waiting," as she runs herself, eyes closed, into the "zone." The interplay of temporal dimensions reflects Lola's trancelike state, while the shifting audiovisual alignment could be read as a metaphor for Lola's "tuning-in" to her inner powers. And indeed her "powers" do deliver: Lola's meditative state is abruptly interrupted by the diegetic sound of screeching tires from a lorry that almost runs her over — and that is how she finds herself, "by chance," in front of the casino. Here we find a strategy quite typical of montage sequences: the diegetic sound of screeching tires pierces the nondiegetic bubble that had been in place for the previous 53 seconds, producing an abrupt switch from floating subjectivity to anchored objectivity.

To summarize, the regular structures of EDM may be effectively utilized to shape and control audiovisual rhythm, not only by establishing simple metric congruency of music and images, but also by exploiting the reliable temporalization afforded by the isochronous pulse to establish complex, polyrhythmic and phasing audiovisual relationships. As Claudia Widgery remarks, with specific reference to music's temporal function in film, "The key is to maintain a balance between integration and autonomy, for both are necessary if the temporal potential of music for film is to be realized" (Widgery 1990, p. 381).

An analysis of *Lola's* musical strategy could not be complete without examining the relationship between the techno music and the other musics included on the film's soundtrack. In the latter part of the first run, the entrance of Dinah Washington's "What a Difference a Day Makes" — immediately after the techno music stops (00.28.30) — creates a strong unexpected contrast of great effect. This cue starts when Lola and Manni flee the supermarket they have just robbed. All diegetic sound is initially suppressed, until the first police car appears (00.28.58). The cue is abruptly cut off by the gunshot-sound that kills Lola (00.29.29), and from the long reverb tail of the enhanced gunshot-sound another contrasting music emerges: this is Charles Ives's *Unanswered Question*, an apt quotation in relation to the interrogatives posed at the film's opening. Thus, we have three moments of strong contrast that take the audience for an affective rollercoaster ride: in the robbery segment we find a



techno soundtrack fully involved in the action; the framing gets progressively narrower until, in the last shot, Lola's face is shown in extra-closeup — we are *with* the characters. As the camera cuts to Lola and Manni fleeing the supermarket, the framing widens considerably into a decidedly objective series of shots; in complete contrast with the involved role of the previous techno, Washington's gentle jazz ballade in 12/8 could not be any more detached from the action, its only connection with the narrative being its lyrics, commenting on time, love and chance in a manner resembling the chorus of ancient Greek theatre; the tension is defused, and the grip on the audience is significantly relaxed — we are now mere witnesses, spatially distant and emotionally disengaged. The gunshot event comes as yet another jolt, abruptly stopping the song, and after a few seconds of almost total silence the musictrack reconnects to the action by introducing the empathetically aligned Ives's music — we are now back into character subjectivity (slowed-down footage, time-stretched sound design, closeup framing), emotionally involved in the couple's muted shock and grief.

Finally, we come to another important element of *Lola*'s soundtrack: the lyrics within the techno music. In line with my account of EDM's features given above, it can be seen that lyrics in *Lola* are largely spoken (except for the "Love is" verses, and a stray line of "Help me," which are sung), and often sonically processed in various ways. Their delivery is monotonic and percussive, adding a further layer of rhythmic emphasis to the mix. Both female and male vocals are included and, significantly, these are only heard in conjunction with Lola's action and never heard when Manni is in the picture. The female lyrics are intended to be understood as Lola's own "voice," and are in fact delivered (mostly) by Franka Potente herself, contributing to an effective characterization of the main protagonist, and thus fostering an emotional bond with the audience. As MacMillan observes, "This non-diegetic overlay of vocals works to provide insight into Lola's sense of identity by representing the character's inner thoughts, fantasies and desires" (MacMillan 2009, p. 111). Indeed, themes of fantasy and desire are conspicuously articulated in the "I Wish" lines, which constitute a sizable portion of the lyrics in *Lola*, and can perhaps be taken as the central theme among the lyrics' sections.<sup>9</sup> These verses include a few cross-references to key motifs in the narrative, specifically: the heartbeat, which refers to both the pulse of the running clock time, as well as the actual heart, that of the racing Lola and that of the security guard (Lola's real father), which stops and is reactivated by Lola's loving powers. A second important cross-reference recurring in these verses is that of the "princess" (with armies at her hand) and "ruler" that Lola wishes to be, a clear desire for power, or at least empowerment. And indeed, "princess" and "royalty" is precisely how she is greeted, sarcastically, by the security guard on her arrival at the bank. These lines seem at odds with the image, commonly encountered in writings, of Lola as a subversive heroine; one might ask: is Lola genuinely critical of the

status quo, or is she merely wishing for more power for herself within a social order that, whether patriarchal or matriarchal, is still based on hierarchical power relations? Alternatively, one may, following Tom Whalen, understand these lines as quotations, as part of the numerous fairy-tale signs diffused through the work. “For what is *Run Lola Run*,” asks Whalen rhetorically, “if not a fairy tale, albeit of the self-conscious, philosophical variety” (Whalen 2000).

In “running two” we observe a change toward a more assertive attitude. The “I Wish” lines temporarily disappear, giving way to three new sets of verses. Two of them are again, supposedly, Lola’s “voice”: the first set constructs Lola as a character determined to rescue her partner (“I want to fight” / “I want to see you again,” rhythmically spoken); the second expresses Lola’s infatuation in more “lyrical” terms (“I can’t think of anything but you,” sung). As they appear interwoven on the soundtrack, these two sets reaffirm Lola’s belief that “love can do everything” (revealed early in the film), a fundamental trait of Lola as a Romantic character. As Grant McAllister puts it, “If there is indeed another discourse in this film’s deceptively postmodern text, it speaks with a Romantic twang” (McAllister 2007, p. 331). Finally, as the third new set of verses in this section, we find male (spoken) vocals exhorting Lola to “never, never, give up” and “do, do the right thing.” It should be noted that these verses are first briefly introduced on female voice (00.34.08 - 00.34.22), before being promptly taken over by a male, which makes attributing that “voice” to any specific character or entity problematic. If, however, we view Lola and Manni as in a Jungian anima/animus relationship, as proposed by Vadim Rudnev (2003), the male voice in Lola’s space may be understood as Lola’s own mythical *imago* of Manni.

Nevertheless, in “running three” the “I Wish” and “Never, Never” verses come together, interwoven, as in a synthesis of the previous two runs,<sup>10</sup> signaling the reunion of the two lovers and perhaps, as some authors have suggested (e.g. Rubenstein 2010), a reconciliation of the genders. But then again there are writers (e.g. O’Sickey 2002) who see a refutation of the reconciliation thesis in the track that plays last over the film’s closing credits. Rapped on male voice, and all in German, “Komm zu mir” has generated some debate for its closing line that states (translated): “I don’t need you any more” (cf. O’Sickey 2002). If this track really is that much of a key to understanding *Lola*, I am wondering whether non-German-speaking audiences are effectively missing something from this film. Consider, also, that one would need to sit through 3.42 minutes of rolling credits to finally catch that very last line.

But why worry about the film’s last line in the closing credits, when *Lola*’s key is so conspicuously on display in the first lines of the opening titles: “after the game is before the

game,” reads one of the two quotations at the very start. “The ball is round, the game lasts 90 minutes,” states Schuster, the security guard, kicking a ball in the air to start the game. Plus: ticking clocks, animated sequences, videogame references, croupier, roulette, multiple-lives characters. These are strong cues in a privileged position within the film’s structure. And considering that Schuster, having stated the basic rules of the game, immediately adds: “anything else is pure theory,” it seems clear that the film is suggesting a particular framework for interpretation. In Whalen’s words: “What is important while viewing *Run Lola Run* is to acknowledge the director’s central conceit of life/art/film as a game” (Whalen 2000).

## 5 — Breakbeat, Noise and Glitch in Darren Aronofsky’s *Pi*

Darren Aronofsky’s *Pi* (1998) offers a good example of a soundtrack in which the diegetic sounds of the action and the nondiegetic music appear to coexist on a continuum, rather than as neatly separate strands. As Kulezic-Wilson notes, “diegetic and non-diegetic sound effects, as well as parts of Max’s inner monologues, are often perceived as part of the techno-score” (Kulezic-Wilson 2015, p. 157). Being remarkably alike in their distinctly noise-based quality, the music, sound design and foley in this film perform as tightly interrelated parts, merging into a unified sonic discourse that renders their distinction often meaningless.

*Pi*’s plot follows a gifted mathematician, Max Cohen, in his obsessive search for the fundamental master-pattern underlying all phenomena. If a pattern could be found within the seeming irrationality of  $\pi$ , whose decimals extend to infinity without, apparently, ever falling into a repeating sequence, then everything has a pattern — it is just a matter of finding the key. In this sense, *Pi* is a tale about the human struggle to understand the world by searching for an order in the chaotic nature of phenomena. This conflict between order and chaos, as painfully lived by the protagonist, is the essence of *Pi*, and the film constructs a robust audiovisual strategy to articulate this conflict convincingly.

Max pursues his quest from his modest flat, kitted out as a rather anachronistically fashioned computer lab — not some tidy desktop machine, but a messy contraption of hacked and precariously put together parts taking up most of his living space. This idiosyncratically lo-tech aspect of the mise-en-scène is matched by the film’s black-and-white photography, characterized by a grainy and overexposed picture quality. Max’s life is punctuated by debilitating headaches; these are dealt by a subcutaneous injection which he administers to himself with a vaccination gun, the effects of which are only felt after a protracted crisis that sees the protagonist contorting in excruciating pain and experiencing hallucinations. The

cinematography is characterized by fast-paced editing, at times becoming a montage of flashing images of disorientating effect; longer takes are themselves often dominated by shaky camera movement. In short, everything in *Pi*'s narrative and visuals screams “noise” — and the soundtrack obliges.

It is quite common to come across writings that characterize *Pi*'s soundtrack as “techno,” but I would like to suggest a sharper characterization, in line with my account of EDM's features, as given in the relevant section of this writing. The main theme, which Aronofsky (1998) designates as the “Max theme,” is actually a most typical version of the “Amen break.”<sup>11</sup> This epitomizes the “breakbeat”-based styles, whereas techno actually belongs to the opposite camp of the basic binary distinction recognized in EDM, the camp of the “four-on-the-floor” styles. Since breakbeat-based patterns originate from real sampled drums from old records, as opposed to the drum-machine-based constructions of techno, they tend toward higher syncopation and irregularity, and are therefore particularly suited to articulate the order/chaos conflict underlying this film's concept. This main theme, which is heard right at the film's opening, sets the tone for the whole soundtrack, which is indeed characterized by various sorts of “breaks.” Aronofsky (1998) mentions hip hop as an influence to his audiovisual style, probably with reference to the common techniques of scratching, sample triggering and punch-phrasing used by DJs. But another equally relevant connection could be made with reference to the “lo-fi” and “glitch” aesthetics, as a distinctive quality pervading both the audio and the visual channels in *Pi*. And this would fit neatly with the film's narrative intent, as the glitch procedure is itself, fundamentally, concerned with reconciling chaos and order, randomness and structure. Moreover, glitch is concerned specifically with the noises of the computer itself: the mechanical whirring and buzzing of printers and peripherals, the electronic beeping of screens and, most significantly, the digital “noise” of information processing: unwanted data, errors, debris in the channel, the noises of malfunction and system failure. We may therefore conceptualize *Pi*'s soundtrack as the sonic manifestation of computation itself as raw, swarming digits. When Max is confident about his latest assumptions, these data coalesce into the positive driving beat of the Amen-break theme — the ordered “pattern” Max is yearning for. When his assumptions are confronted with the chaotic reality of  $\pi$ , however, a critical limit is reached: the computation crashes, spitting out random digits that refuse to arrange themselves into anything other than a disorderly state that translates on the soundtrack as screaming sonic matter.

The same processes that drive Max's computer, Euclid, apply to Max himself, since the two operate in a symbiotic relationship. It is significant that Max sits at the center of a computer system that completely surrounds him and almost engulfs him. As Tarja Laine has pertinently

observed, “The relationship between Max and Euclid can be characterized as prosthetic, which Marshall McLuhan defined as a physical extension of the self by means of media” (Laine 2017, p. 28). In this symbiotic relationship, Max and Euclid crash and melt together as they struggle to find the key that could unlock the mystery of life.

For Euclid, meltdown is a blown microchip; for Max, though, it is acute physical and existential pain. But the cause of the breakdown is the same — their preoccupation with  $\pi$ . Effectively, *Pi*’s narrative is predicated on the “forbidden knowledge” trope — that which will blind you/maim you/kill you. This is implied quite literally at the film’s opening: already as a child Max had to endure temporary blindness because he wanted to “see the Light.” This episode from Max’s childhood sets the excuse for the subsequent attacks, while other elements intervene to add a layer of ambiguity to the narrative, i.e., Max’s compulsive behavior and psychological state, which throws into question whether what we see is actually happening to Max or whether it is simply imagined. But essentially, Max is (or becomes, following his sun staring) a prodigious child (“published at 16, PhD at 20,” as we learn from his teacher) whose inquisitive nature keeps pushing him ever further toward “dangerous” knowledge, and his suffering gets increasingly worse as he seems to be getting closer to discovering *The* pattern. “You fly too high. You’ll get burnt,” warns Sol, his teacher who, on his part, has in fact already suffered a stroke *while* working on  $\pi$  and apparently getting close — too close, obviously — to the answer: he knows of the 216-digit number and of the meltdown it causes, in which supposedly the computer becomes “aware of its own structure.” After his first stroke, Sol had given up his quest; and the moment he resumes his work, spurred by Max’s findings, he suffers the second, fatal stroke. When Max enters his mentor’s apartment, he finds a handwritten paper showing a series of numbers, which is to be understood as the key to  $\pi$  — that which has killed the old man. Max takes the paper home and there, while contemplating the numbers, he has his final, most violent attack, after which he decides to eradicate his knowledge of the code by burning the paper and drilling a hole in his skull. Supporting and corroborating the “forbidden knowledge” trope, is a related trope: only the “pure,” or the “chosen,” can be admitted to the “ultimate truth,” can bear with impunity the vision of the “Light,” etc. And indeed Max eventually declares himself to be the “chosen one” to the Hasidic Jews who are trying to coax his services. Learning from Rabbi Cohen that the 216-digit number is the “true name of God,” Max mutters: “That’s what happened: I saw God!” That is why the migraine attacks are treated so prominently in the narration, with both the cinematography and the soundtrack richly elaborating on the symptoms and the devastating effects experienced by the protagonist. Understood in the context outlined above, the migraine sections are no longer a question of the narration dispensing a dose of discomfort to the audioviewer simply as a way of characterizing Max as

a troubled paranoid, but a way of articulating a more fundamental tenet of *Pi*'s construct: the agony of pursuing, or beholding, that which is beyond human comprehension.<sup>12</sup>

In *Pi* this ancient trope is tastefully reworked into a more contemporary version that adds a strong psychological dimension to the drama; this is achieved particularly through a highly subjective filmmaking style. The range of knowledge made available by the narration is severely restricted to the protagonist's experiencing of the events, and the cinematography is replete with Max's POV shots. We perceive largely through Max's senses, and this fact generates a grey area of film space in which sounds can never be fully diegetic or nondiegetic. In *Pi*, sounds exist in the liminal, "in-between" space opened up by the subjective narration. In this osmotically structured space sounds float, rather than being firmly anchored to their supposed origin, and can therefore perform as a unified, cohesive sonic-scape signifying at more than one level simultaneously. Thus, for example, a sound could be referencing diegetically a certain detail of the action (e.g. computer beep, printer noise, keyboard tapping, etc.) while functioning at the same time as a "musical" element. Cast into this dual role, sound acquires a more abstract, symbolic significance beyond its mimetic function — it is no longer merely indicating "the computer is beeping" or "the printer is buzzing," but is conveying to the audioviewer the full dramatic implications of such sonic outputs.

As an example, we could look at the sequence starting at 00.04.00. The image crossfades from an exterior shot showing a tree top to an interior shot framing the scrolling LED display of Max's computer set up. Over a nondiegetic synth sound continuing from the previous shot (though with a slight variation in its pitch pattern, now reiterating C-C-F-Bb), we hear a complex of other sounds with a supposedly diegetic origin, all connected to the machine's workings, amongst which: an indistinct low hum, a touch of white noise peaking at certain points, and a rather dense series of faint, random beeps. When the camera frames the blinking cursor on the computer screen, a more prominent, regular beeping appears on the soundtrack, initially beating roughly at half note intervals. Max presses the return key (key close up) and the beeping doubles in speed (in synch with data appearing on the screen), metrical for a short time, but soon refusing to settle into a regular pattern. Instead, the groove promised but not realized by the beeping is promptly taken over by the printer's buzzing sound articulating a ternary pattern. A telephone ringing joins the soundscape, and the synth motif is replaced by a bass drone, signaling the ominous nature of the call. In quick rhythmic succession, the printer's sound pattern ends on the briefly sustained tone of the paper ejecting (printer closeup), Max slams the handset down (Max closeup), and tears off, with conspicuous sound, the paper printout (printer closeup); on which shot the sequence sharply ends (00.04.57).

In this short excerpt, the diegetic sounds, heard over the minimal harmonic support of the nondiegetic track, acquire a “musical” sense — not necessarily as metrical patterns but as freer motifs interacting with the images to create a more complex audiovisual rhythm: fragments of patterns articulating the order/chaos tension underlying the narrative, and the elusiveness of the order Max is striving for. These are not just mimetic sounds reproducing a supposed “reality,” but narratively significant structures conveying a bundle of affects, e.g., the anxious anticipation of the results following Max’s pressing of the return key, the implications of Max committing himself further into the perilous quest, and so forth.

Two factors are at work to enable this strategy. One is the consistency of the sonic palette: it is thanks to the well focused strategy outlined above — the idea of an overall sonic print meaningfully based on digits and breaks — that integration is achieved. The second is the purposeful structuring of events into rhythmic patterns across audio and visuals; this is indeed a fundamental characteristic of the whole film. As Kulezic-Wilson remarks, “In the same way Max believes everything we touch is infused with the pattern of a spiral, so is  $\pi$  permeated with repetitions and patterns in all elements of its narrative and audio-visual structure on both the micro- and macro-levels” (Kulezic-Wilson 2015, p. 140).

Thus we have patterns of pill taking, door locking/unlocking, migraine attacks, recurring verbal statements, and so on. Of these, the shorter motifs, like the pill taking, or the lock/unlock action, are of particular interest as audiovisual structures. These are miniature sequences of rhythmically organized audiovisual montage, striking in their speed and brevity — the pill-taking sequence lasts only two seconds, cut into four shots, themselves filled with fast movement within the frame (extreme closeups). Here the role of sound is significant in achieving the desired effect. Beside providing an acoustic rendering to the visually represented, sound here performs two important (overlapping) functions. The first is what Chion (1994) labeled the *spotting* function. Chion noted this crucial role with regard to rapid visual movements in fight scenes: “The ultrabrief image of the punch all by itself would not become engraved into the memory, would tend to get lost. But an ultrabrief but clearly delineated sound has the advantage of etching its form and tone directly into consciousness, where it can repeat as an echo” (Chion 1994, p. 61). It is sound that makes us register (audio-)visually such a fast succession of images; this is particularly important in the context of *Pi*, in which this sequence needs to be recognized by the audioviewer as a repetition at various points in the film. The second function accomplished by sound is to make the sequence perceptible as a well defined rhythmic structure, thus turning it into a self-contained symbolic unit predisposed to be re-deployed to form larger patterns at a higher structural level. This device has the effect of transposing a simple action into a more complex idea — a sharp,

stylized audiovisual gesture with a precise narrative function, compressing time and meaning to make its point with maximum efficiency. As Kulezic-Wilson elaborates, “In its first appearance the pattern indicates the repetitiveness of the action, which for Max is an unavoidable routine, but later suggests also the urgency of it, the anticipation of the pain and the fear that follows it” (Kulezic-Wilson 2015, p. 144).

The fact that Aronofsky has referred to these punchy structures as “hip hop sequences” (Aronofsky 1998) is indicative of the musical thinking behind the director’s individual style. Indeed, one of the interesting aspects about the phenomenon discussed in this writing has to do with the influence exerted by the particular structures of EDM on filmmaking style — it is not simply a case of swapping an orchestral score for an EDM track, but a significantly different approach to filmmaking, with a strong commitment to an integrated audiovisual strategy, and keen to exploring and exploiting the features of EDM structures to such ends.

Nevertheless, musically-aware filmmaking, and EDM-influenced film structures in particular, need not be all about metrically organized material and audiovisual structural congruence. Indeed, I would suggest that it is precisely because EDM structures, as Katherine Spring correctly notes, “facilitate accent structure alignment” (Spring 2010) that special care needs to be exercised in organizing audiovisual material, ensuring an appropriate balance between synchrony and asynchrony across all elements of audio and visuals. Devices like Aronofsky’s hip hop sequences, for example, are only effective as “breaks” as long as there is a “flow” to contain them. Overused, the device would soon lose its power. Similarly, a strategy based predominantly on congruency between audio and visual accent structures would soon defeat its purpose — if everything is emphasized, nothing is significant. In this respect, the audiovisual team who worked with Aronofsky on *Pi* did a very good job at exploiting the full range of relationships. And here it is not just a question of aesthetic refinement — the film relies on contrasting modes of synchronization to articulate the chaos/order conflict underlying its narrative.

Evidence of a strategy that carefully avoids beat-matching in favor of more sophisticated audiovisual relationships can be found practically throughout the film; already in the short excerpt analyzed above a careful balance can be seen between metrical and free-flowing relationships. The effect can be quite subtle at times and yet significant, as in my next example, a case of composed asynchrony within a groovy section. At 00.16.40 we find the first occurrence (after the opening titles) of the main theme. As I said above, this theme is triggered at points where Max is confident about his assumptions, hence the reassuringly ordered metrical pattern. First we hear the intro segment of the theme over Max’s stated



assumptions; then the full Amen-break pattern kicks in (00.17.09), in response to Max's question, "so what about the stock market?" And finally, when Max states "press return," the pattern stops on the first beat of the 4/4 bar (00.17.32). These are the "rational" relationships on which the sequence is organized. Nevertheless, first it can be observed that film editing over the above segment is consistently avoiding cutting on the beat, articulating instead its own independent rhythm — vertical (audiovisual) relationships are non-metrical. Second, asynchronous relationships can be observed within elements of the soundtrack, too: when Max states "press return," his fingers hesitating over the keyboard (00.17.32), the Amen-break pattern stops, and a single-line electronic pulse emerges. Over this nondiegetic tone that continues to mark beats one and three of the bar, we hear the supposedly diegetic electronic beep associated with the blinking cursor on Max's computer screen, apparently pulsing at the same rate as the nondiegetic tone, and placed — initially — on beats two and four. However, this relationship gradually goes out of phase until, after 22 bars, the computer beep has shifted to beats one and three, and the Amen break resumes on the first beat of the 23<sup>rd</sup> bar, in synch with Max's pressing of the enter key (00.18.04). This may seem a trivial detail; but suppose the two electronic tones had continued in the same metrical relationship over 22 bars, backbeat disco style (tuh-beep-tuh-beep...) — the tension would be significantly defused by the reassuringly predictable beat; the re-entering of the Amen break would lose its impact as the first synch point after 32 seconds of asynchrony; and the complex signification of acute conflict at that crucial moment (to press or not to press the return key?) would be lost. In short, there are some metrically organized relationships at one level of structure, but even here — a section featuring the groovy main theme — contrasting modes of synchronization can be seen at work. In fact, it is precisely thanks to the asynchronous elements that the two key moments in the sequence marked by the stop and re-start of the Amen break obtain their effectiveness *as* synch points.

A much more obviously complex example can be seen starting at 00.47.52. This sequence plays a situation similar the previous example (the protracted interval between Max stating "press return" and his eventual pressing of the key) though in a further intensified manner, with Max now deep into the snares of  $\pi$ . Here we find no less than four independent rhythms on the soundtrack: one is a diegetic screen-cursor sound beeping roughly at quarter-note intervals; three are nondiegetic synth lines: one playing a slow 4-note loop in mid-low range (C-G-Eb-Bb), another playing a groovy 1-bar loop reiterating G in mid-high register, varied by dynamic filtering; the third (fading in at around 00.48.30) is the familiar synth tone in low-mid register associated as a leitmotif to the impending migraine attacks, pulsing at roughly quarter-note intervals. These four loops are all playing as independent lines, in continuously shifting relationship to each other and with absolutely no sense of a common meter. To these

we may add as a fifth rhythmic element the lovemaking sounds attributed to Max's neighbor, Devi, which also have a carefully constructed flow of peaks and dips. Meanwhile, on the image track, after a pill-taking sequence is punched in, a long take is started (00.48.30 to 00.49.06), showing Max nervously walking in circles around his lab, followed by the camera, creating a complex visual rhythm combining figure and camera movement; this constitutes a sixth independent line of rhythm, accelerating over the course of the shot. The audiovisual result could not be any more sophisticated in its purposeful and carefully composed complexity, generating a multiplicity of time-levels which, while not quite rational in their relationship to each other, can be grasped in their totality as a state of stable instability. This sequence, like many others in the film, shows a carefully controlled balance between synchrony and asynchrony, metrical and free-flowing structures as a deliberate strategy for *Pi* — the rational and the irrational are featuring as inextricably linked elements in this drama.

I would finally like to touch on the important migraine sequences. The attacks always start with a twitching of the thumb (closeup) sonified by subtle bursts of white noise, the typical sound indicating interference, corrupted data, malfunction in a digital system. This is soon followed by a pulsating synth tone marking quarter-note intervals; this sound strongly recalls the typical warning tone indicative of system failure, an “alert” sound, often a signal of impending disaster. Here, though, it is realized in a more sophisticated way: it is made of two attacks placed on the first and second sixteenth notes of a crotchet, the first a low G, the second a G an octave above. As the loop is subtly manipulated by dynamic filtering, over the course of its duration it is possible to hear the downbeat shifting to the high G. It remains nevertheless stable enough as an isochronous pulse, and it functions as a unifying backbone to the sequence, temporalizing the images with a reliable chronometric reference and a sense of continuity. Another sound emerges, a rather abrasive timbre alternating Ab and G below (m2) as a slower loop in mid-high register, adding to the tension by the dissonant minor 9<sup>th</sup> formed with the fundamental G of the “warning” tone. Finally, the more intense sounds directly associated with Max's pain appear. In the first crisis (00.08.25) we find a fast-spinning loop alternating two pitches roughly equivalent to quavers, screaming in high register. On the second beat of its fourth bar, this loop appears to trigger a still higher and shriller sound (roughly F#), sustained a few seconds and then morphed into a mellower sustained tone (roughly F). There is, in addition, a mid-low howling sound expanding Max's vocal laments. Most importantly, this “pain-sound” complex is triggered by a punched-in structure lasting half a second and consisting of two intense shots over a noisy tone combining a high frequency and a low frequency signal; this is repeated after a while, and when retriggered a third time it cuts off the pain-sound.

Thus, we have three clear signals of malfunction in logical succession of increasing severity that function to characterize the migraine attacks as a case *analogous* to “system failure”: first the glitchy statics over the twitching thumb, the initial symptoms of corrupted data; second the obsessive warning tone, and finally the distinctly “broken” quality of the punched-in micro-events, these latter triggering the spinning pain-sound. Very much like Euclid’s chip, Max’s brain, faced with the irreducible complexity of  $\pi$ , reaches overload and “crashes.” The computation (as explained by Sol) “gets stuck in a particular loop” and the system “spits out a long string of numbers.” The spinning pain-sound, thus, could be understood as a supposed decoding of those numbers into sonic information, as if that data could simply be fed to a D/A converter and output as sound waves — the enigmatic 216-digit code is made audible, and it’s not pretty. This idea strongly recalls a typical procedure of glitch, which consists in forcing the computer to convert the raw data from non-audio files (e.g. ascii text, pictures, etc.) into audio signal.

In summary, even after twenty years since its release *Pi* remains one of the finest examples among films exhibiting an “integrated soundtrack,” an approach to film sound discussed in current literature as a strategy of “blurring the line between music and sound design” (Kulezic-Wilson 2017, p. 129). While such an approach is not entirely new, an increasing trend in this direction has been observed in films of the past 20 years. This trend is often portrayed by writers as a “musicalization” of the soundtrack (Donnelly 2013, p. 366). But of course, we could equally talk of a “noisyfication” of the musictrack. The musical revolution started by the likes of Russolo, Varèse, Cage, and Schaeffer brought “any and all sounds” (Cage 1961, p. 4) into music practice. This aesthetics eventually influenced (directly or indirectly) various forms of popular music, among which EDM is perhaps the genre that most consistently embraces the noise-sound approach to musicmaking. When the inclusive logic of such an aesthetics is taken into film, the boundaries between soundtrack elements are severely undermined — nondiegetic “music” will tend to absorb the diegetic sounds into its noisy structures, turning them into sonic “gestures,” while the diegetic space will tend to attract the “music” into its environment, making it its “ambience.” The resulting ambiguity can be purposefully exploited by filmmakers for effective signification, as well illustrated by *Pi*. But in *Pi* this strategy is particularly effective because its sonic materials are so well connected conceptually to its subject: in this drama of numbers, digits, data processing, information and knowledge, the integrated-soundtrack approach (as a stylized idiom) frees the “noise,” the “ruptures,” the “overloads” and the “breakdowns” from their indexical function, turning them into powerful signifiers functioning simultaneously at the literal and the symbolic levels.

## 6 — Conclusions

The distinctive traits of EDM offer substantial possibilities to narrative cinema, especially with regard to the structuring of audiovisual rhythm, and the integration of soundtrack elements (music, sound design, foley, dialogues) into a synergetic whole.

As a groove-based music, EDM can supply a reliable pulse against which the flow of the images and narrative can be related and experienced by an audience. Its emphasis on rhythmic structures at the expense of melodic and harmonic development can be harnessed to invest film sequences with a marked sense of kinesis, transposing “a purely visual experience of motion into a visceral one as well” (Widgery, 1990, p. 384). Its open, non-developmental form, with no clear beginning and ending, makes it particularly flexible for cutting scenes to musical sections, and its metrical organization facilitates the “cross-modal alignment of accent structures” (Lipscomb 2013), including the precise alignment of beats and bars to the film’s editing rhythm or to specific visual events, a device that could be exploited to construct calculated patterns of audiovisual rhythm. I have suggested in this essay that this latter property of EDM calls for considered handling. While the stylized and even musicalized effect produced by metrically organized audiovisual structures can be exploited purposefully for specific narrative ends, the device can easily become ineffective if overused. Audiovisual structural congruency is not the only, or even the most effective, device for bringing audio and visual into meaningful interaction; the features of EDM offer a wide spectrum of possibilities for structuring audiovisual rhythm, as illustrated by the analyses in this writing.

The synthetic and noise-based sound of EDM facilitates integration with other elements of the soundtrack. This is enabled particularly by the vertical openness of EDM’s form, evolving through constant addition and subtraction of layers and therefore capable of assimilating diegetic sounds as part of its structure. A sonically integrated audio track offers a wider spectrum of possibilities for signification, as all soundtrack elements can be manipulated and structured into symbolic units to articulate a more complex meaning, richer in connotations and capable of making a narrative point with maximum efficacy.

The two films analyzed in this essay are prime examples of the possibilities highlighted above. But what is crucial about both films is that their “integrated” nature is first of all the result of a procedural approach to filmmaking that engages with the soundtrack at an early stage of production, rather than leaving it to the last, as is most often the case. Integration starts at the conception stage, and implies a filmmaker’s awareness of the potentialities of sound in film.

In certain cases we see the directors themselves contributing directly to the soundtrack, as is the case with Tykwer, who composed/produced the music for *Run Lola Run* in collaboration with Johnny Klimek and Reinhold Heil. This approach is also a reflection of a changing practice brought about by technological developments. As Claudia Gorbman notes, “Over the last twenty years the advent of digital recording and storage of music as well as of digital video editing have made it possible for directors to exert much greater control over the selection and placement of music in their films, and has liberated the music soundtrack from the rarefied province of specialists” (Gorbman 2007, p. 151). To this we may add the changes in industry models over the same period, which saw a decreasing monopoly of the major Hollywood studios and the rise of the independent studios, smaller entities with less rigid divisions of specialism compared to the highly compartmentalized structures of the historic studios. But whether the directors are themselves contributing to the soundtrack is not the essential point; filmmaking is always a collaborative enterprise. What matters is a director’s understanding of the possibilities offered by sound in film, and of the necessity of involving sound specialists at an early stage of conception and in a collaborative, two-way relationship. A promising trend in this direction can be observed in recent years, with a growing number of directors seeking a deeper engagement with sound in their films. Significantly, this approach is often defined by a particular interest in sound design, and this constitutes a fertile ground for EDM, given its special ability to integrate with, cross into, or function as sound design. Such developments in filmmaking practice, coupled with a changing aesthetic sensibility craving alternatives to conventional orchestral scoring, will likely result in an increasing presence of EDM in film and an increasing range of opportunities for EDM practitioners.

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### **Notes on Contributor**

Roberto Filoleta (PhD) is a composer, sound artist, performer. He is currently a Principal Lecturer at the University of Hertfordshire, UK, with the role of Programme Leader for the MSc Music and Sound for Film and Games, and the MSc Music and Sound Technology.

# Notes

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<sup>1</sup> This is consistent with the notion expressed by Butler that, “Historically, [...] EDM has been defined by its relationship to the dance floor” (Butler 2003, p. 8).

<sup>2</sup> *Run Lola Run* includes some non-EDM music as quotation and sharp contrast (effectively a kind of Eisensteinian dialectical montage in the audio domain), but nothing like conventional orchestral film music.

<sup>3</sup> Moments of total absence of meter do occur, but only temporarily, as intros, outros, interludes. Eventually the meter must be (re)established.

<sup>4</sup> I am aware that a few authors consider beatless (sub-)genres as part of the EDM umbrella. As clarified in the introduction, in this essay I am only concerned with the beat-driven genres that constitute the core of the EDM repertoire as a music *for* dancing. Significantly, Mark Butler refers to the beatless within EDM as an anomaly: ““Ambient,” or “downtempo,” is something of an anomaly within EDM, in that it is slow and often beatless” (Butler 2003, p. 90).

<sup>5</sup> It is important to note that Eisenstein’s theories went through two distinct phases. The example from *Strike* reflects his “dialectical” phase, which emphasized tension and shock as a montage principle (montage of *attraction*), whereas in his second phase (from 1930) he regressed to a notion of unity and synthesis of elements more akin to the Wagnerian *Gesamtkunstwerk*, a position he had originally repudiated. See Bordwell (1974 and 2005) for a detailed account.

<sup>6</sup> See Calavita (2007) for a robust critique of the “MTV aesthetics trope,” which Calavita characterizes as a “film criticism fallacy.”

<sup>7</sup> I am referring to Nicholas Cook’s general theory of multimedia which, very succinctly put, posits three basic models: *conformance*, characterized by a relationship of congruence between media; *complementation*, exhibiting a degree of “undifferentiated difference;” and *contest*, marked by “collision or confrontation” between media (Cook 1998, p. 102).

<sup>8</sup> See note 7, above.

<sup>9</sup> Caryl Flinn maintains that “Believe” constitutes “the central musical theme of the film” (Flinn 2004, p. 205), even though this track is never actually heard in the film. Flinn seems to rely too much on the audio CD version for her analysis. While such an approach may be perfectly appropriate for Flinn’s predominantly cultural analysis of *Lola*, in this writing I am specifically focusing on the experience provided by the film itself.

<sup>10</sup> See Whalen (2000) for a detailed account of *Run Lola Run*’s dialectical structure as thesis, antithesis and synthesis.

<sup>11</sup> The term “Amen break” refers to a 4-bar drum solo found in “Amen, Brother” (1969), performed by The Winstons. This has become the world’s most sampled audio segment; its structure forms the basis of many breakbeat-driven styles, e.g., hip-hop, drum ‘n’ bass, jungle, etc.

<sup>12</sup> Cf. Anderson (1998), who writes off the migraine scenes as gratuitous: “When the plot sticks with the math, its [sic] genuinely exciting and interesting, but when we go to Max’s headaches and hallucinations, we get into some seemingly gratuitous nightmare imagery (brains, blood, tumors, etc.) that will turn some people off” (Anderson 1998).

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*Blade Runner*, 1982. Directed by Ridley Scott. USA.

*Fight Club*, 1999. Directed by David Fincher. USA / Germany.

*Go*, 1999. Directed by Doug Liman. USA.

*Hanna*, 2011. Directed by Joe Wright. Germany / UK / USA / Finland.

*Human Traffic*, 1999. Directed by Justin Kerrigan. UK / Ireland.

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*Layer Cake*, 2004. Directed by Matthew Vaughn. UK.

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