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How rhythmical is hexameter: a statistical approach to ancient epic poetry

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In this paper, I argue that the later a given specimen of hexamater is, the less rhythmical it tends to be. A brief discussion of the background of ancient Greek and Latin metrics and its connections to orality is followed by an account of spectral density analysis as my chosen method. I then go on to comment on the experimental data obtained by representing several samples of ancient poetry as coded sequences of binary values. In the last section, I suggest how spectral density analysis may help to account for other features of ancient meter.

The ancient epic poems, especially the most archaic Greek poetry attributed to Homer, are usually referred as an extraordinary fact in the history of European literature. For present-day readers educated in a culture of writing, it seems unbelievable that such a large body of poetry should have been composed in a culture based on oral transmission. In fact, despite of genuine singers' and audience's memory, epic poems did not emerge at once as fixed texts, but they were re-composed in each performance (Lord 2000, Foley 1993, Nagy 1996). The surviving ancient epic poetry displays some features that reflect archaic techniques of oral composition, formulaic structure being probably the most characteristic (Parry 1971: 37-117).

Since formulaic diction prefers some fixed rhythmical patterns (Parry 1971: 8-21), we can ask some questions about the role of both versification and rhythm in oral composition. Why was all of ancient epic poetry, both Greek and Latin, composed in one particular type of meter called hexameter? Does the choice of meter influence the rhythmicity of a text? Why does hexameter, in

spite of its relatively restricted possibilities of shaping rhythm, differ so much from one writer to another some (cf. Duckworth 1969: 37-87)? And, last but not least, what possible reasons are there for those wide differences between particular authors?

It is commonly known that poetry is in general easier to memorize than prose, because rhythm itself tends to facilitate memorization. In a culture without writing, memorization is crucial, and much depends on the quality of oral transmission. In epic poems from an oral culture rhythm is thus likely to be particularly important for both singers and hearers, even though they need not consciously perceive poetic texts as rhythmical to benefit from rhythm as an aid to memory.

It may then be expected on theoretical grounds that non-oral poems, such as the Latin epic poetry or the Greek hexameter of the Alexandrian age, will be largely non-rhythmical, or at least display weaker rhythm effects than the archaic poems of Homer and Hesiod. Although formulaic diction and other techniques of oral composition are noticeable mostly in Homer's epics (Parry 1971, Lord 2000, Foley 1993, etc.), the later hexameters, both Greek and Latin, also display some features of oral diction (Parry 1971: 24-36). The metrical structure of hexameter might be quite similar: strongly rhythmical in the oldest (or rather, the most archaic) epic poems, and less conspicuous in poems composed in written form a few centuries after Homer. The aim of the present study is to test the hypothesis that the later a given specimen of hexameter is, the less rhythmical it tends to be.

Because of its nature versification easily lends itself to statistical analysis. A great deal of work has already been done in this field, including studies of Greek and Latin hexameter (Jones & Gray 1972, Duckworth 1969, Foley 1993, etc.). However, the main disadvantage of the methods applied in existing research is that they describe a given meter as if it were a set of independent elements, which is actually not true. In each versification system, the specific sequence of elements plays a far more important role in establishing a particular type of rhythm than the relations between those elements regardless their linear order (language "in the mass" vs. language "in the line"; cf. Pawłowski 1999).

Fortunately, there are a few methods of statistical analysis (both numeric and probabilistic) that study verse by means of an ordered sequence of elements. These methods include, for example, time series modeling, Fourier analysis, the theory of Markov chains and Shannon's theory of information. In the present study, spectral density analysis was used (Gottman 1999, Priestley 1981, etc.). Spectral analysis seems to be a very suitable tool because it provides a cross-section of a given time series: it allows us to detect waves, regularities and cycles which are not otherwise manifest and open to inspection. In the case of a coded poetry sample, the spectrogram shows not only simple repetitions of metrical patterns, but also some subtle rhythmical relations, if any, between distant lines or stanzas. On a given spectrogram, a distinguishable peak indicates the existence of a rhythmical wave; numerous peaks suggest a quite complicated rhythm, while a pure noise (no peaks) on the spectrogram reflects a non-rhythmical data.

To verify the hypothesis of hexameter's decreasing rhythmicity, 7 samples of Greek and 3 samples of Latin epic poetry were chosen. The specific selection of sample material was as follows: 3 samples from Homeric hexameter (books 18 and 22 from the *Iliad*, book 3 from the *Odyssey*), 1 sample from Hesiod (*Theogony*), Apollonius (*Argonautica*, book 1), Aratos (*Phainomena*), Nonnos (*Dionysiaca*, book 1), Vergil (*Aeneid*, book 3), Horace (*Ars poetica*), and Ovid (*Metamorphoses*, book 1). In each sample, the first 500 lines were coded in such a way that each long syllable was assigned value 1, and each short syllable value 0. Though it is disputed whether ancient verse was purely quantitative or whether it also had some prosodic features (Pawłowski & Eder 2001), the quantity-based nature of Greek and Roman meter was never questioned. It is probable that rhythm was generated not only by quantity (especially in live performances), but it is certain that quantity itself played an essential role in ancient meter. Thus, in the coding procedure, all prosodic features were left out except the quantity of syllables (cf. Jones & Gray 1972, Duckworth 1969, Foley 1993, etc.). A binary-coded series was then obtained for each sample, e.g., book 22 of the *Iliad* begins as a series of values:

11100100100100111001001001001110011100100100011...

The coded samples were analyzed by means of the spectral density function. As might be expected, on each spectrogram there appeared a few peaks indicating the existence of several rhythmical waves in the data. However, while the peaks suggesting the existence of 2- and 3-syllable patterns it the text were very similar for all the spectrograms and quite obvious, the other peaks showed some large differences between the samples. Perhaps the most surprising was the peak echoing the wave with a 16-syllable period, which could be found in the samples of early Greek poems by Homer, Hesiod, Apollonius, and Aratos (cf. Fig. 1). The same peak was far less noticeable in the late Greek hexameter of Nonnos, and almost absent in the samples of Latin writers (cf. Fig. 2). Other differences between the spectrograms have corroborated the observation: the rhythmical effects of the late poems were, in general, weaker as compared with the rich rhythmical structure of the earliest, orally composed epic poems.

Ovid, Metamorphoses 1,1-500: spectral density function
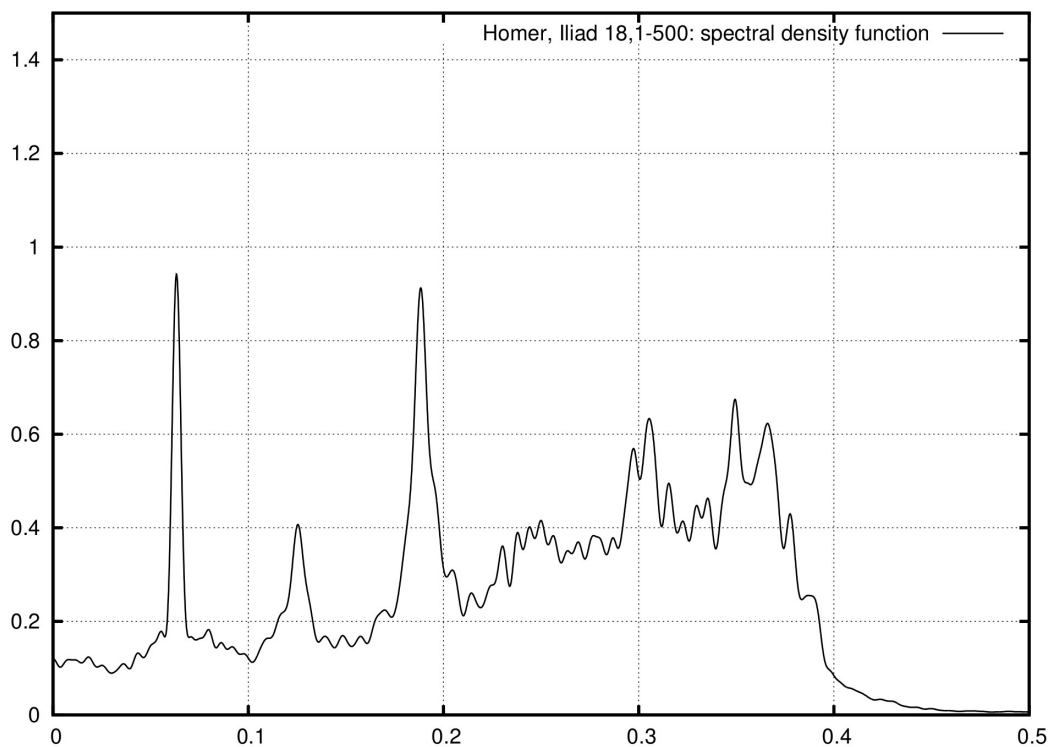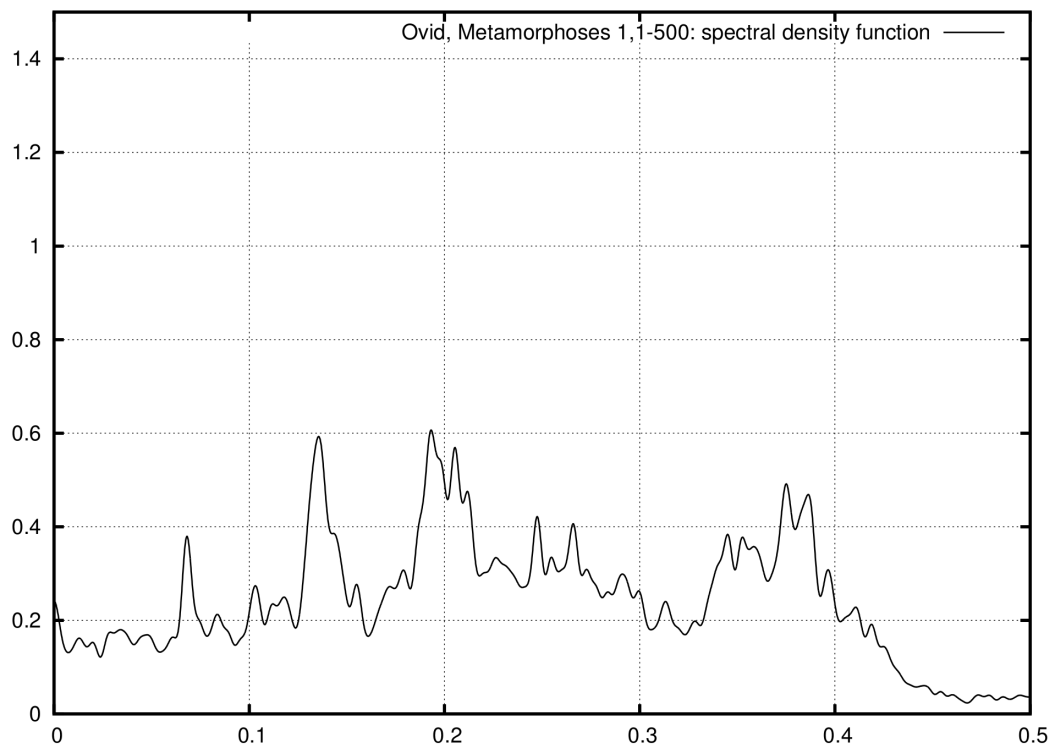
Although the main hypothesis has been verified, the results also showed some peculiarities. For example, the archaic poems by Homer and Hesiod did not differ significantly from the poems of the Alexandrian age (Apollonius, Aratos), which was rather unexpected. Again, the rhythm of the Latin hexameter turned out to have a different underlying structure than that of all the Greek samples. There are some possible explanations of those facts, such as that the weaker rhythm of the Latin samples may relate to inherent differences between Latin and Greek. More research, both in statistics and in philology, is needed, however, to make such explanations more nuanced and more persuasive.

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