Analyzing atonal music: Pitch-class set theory and its contexts

Michael Buchler [a]

[a] Florida State University, USA

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis
Taylor & Francis Group

BOOK REVIEW

Analyzing atonal music: Pitch-class set theory and its contexts, by Michiel Schuijer, Rochester, NY, University of Rochester Press, 2008, xviii + 306 pp., US$90.00, ISBN 978-1-58046-270-9

The history of pitch-class set (pcset) theory as a modern and distinctly modernist methodology for music analysis can be traced back to its origins in the late 1950s and early 1960s, through its codification and expansion in the 1970s, and into a period of somewhat decreased usage approximately since the late 1980s. With enough chronological distance separating us from the methodology's genesis and its most intense period of methodological saturation in our field, the time is ripe for a broad historical account of what pcset theory entails (and entailed) and how it attained canonical status in (especially in North American) higher education. Michiel Schuijer has produced a fascinating and meticulously researched account of the rise of pcset theory and his book should be in the hands of everyone who teaches and has been taught this method and of everyone who cares about the history of ideas in music theory.

My endorsement should not be read as a blanket agreement either with the arguments that Schuijer makes or with each of the conclusions that he draws. I found myself wanting to write two separate reviews of this book: one about the book's transmission of central pcset theory concepts and the other about its critical and historiographical perspective. The first might be a bit lukewarm (I do not think that this book will find much use as a graduate textbook), but the second would be tremendously enthusiastic. At times, the author becomes mired in the wonkiness he is trying to chronicle and the tone of the book can shift quite suddenly from explanatory to critical. In the critical portions, I invariably found myself highly engaged with the author's arguments, often nodding (and sometimes shaking) my head as I turned the pages. Regardless of whether I was sympathetic with his perspective, I found that a close reading of his book helped me to crystallize my own views about pcset theory and its applications.

In order to explain the various facets of pcset theory to readers outside the discipline, Schuijer necessarily devotes extended portions of his book to defining terms and describing the objects and relations that most of us – certainly almost all of us who did graduate work in music theory and composition in North America – take for granted. I dare say that a majority of this journal's readers will not learn much new about the objects and lingua franca of pcset theory. On the other hand, Schuijer offers a refreshingly detached European perspective and he lays bare the assumptions that many of us North Americans have simply come to accept. In particular, I learned quite a lot about the history of formalist music theory pedagogy from the final chapter of his book and I simultaneously wondered whether I should be rebelling from the North American way of doing things or defending what I learned and now teach in graduate courses. I also felt that certain of Schuijer's criticisms are not especially germane to the contemporary state of the field but are rather aimed at decades-old research. (However, even as I write that, I lament the fact that at many

American colleges and universities, atonal theory pedagogy has changed little since the 1970s and 1980s, when basic pcset theory became entrenched in our undergraduate curricula.)

The eight chapters of *Analyzing Atonal Music* follow something of an ABA form, where Chapters 1, 7, and 8 provide substantial historical and critical context for the growth of pcset theory as a movement, while the interior chapters describe, sometimes in great detail, the objects and procedures of pcset theory. Readers should not be lulled into imagining either that the outer chapters provide only background information or that those middle chapters include nothing but description and history. Criticism is interwoven throughout, and the introductory and concluding chapters neither merely anticipate nor recapitulate motives that are developed in the book's interior.

The opening chapter, 'Pitch-class Set Theory: An Overture', provides a compelling preamble to the book, raising questions about what we consider central when we undertake an analysis using the tools of pcset theory. Schuijer challenges Lerdahl's [1] opinion that we should aim for a 'listener-based theory of atonal music – a theory along the lines developed in [Lerdahl and Jackendoff's] *A Generative Theory of Tonal Music*' [2] (p. 25). Rather, according to Schuijer,

> [W]e should ask ourselves whether it is fair to want an analytical theory to be based on the musical intuitions of a listener. Should it pass a 'reality check'? Should examples from manuals and textbooks of music analysis – or the observations of music students, for that matter – be rejected or modified when they fail such a check? Quite apart from the question of which form an inquiry into the empirical groundings of the theory should take – a very complex issue – it might simply not be its purpose to match a verifiable reality. (p. 25)

Schuijer follows that enormous question with perhaps the biggest question of all: 'What, then, *is* an analytical theory of music? How does such a theory come into being, and how does it function? To which needs does it respond, and what kind of hold does it have on our musical imagination?' (p. 25)

Schuijer acknowledges that some of the methodological debate in which we engage stems from our varied analytical desires and expectations. Do we care about structural forces that are not readily perceived (or heard at all)? Do we care about labelling things that *are* readily perceived if they seem structurally uninteresting? Regardless of how or whether we answer these fundamental questions, it is clearly healthy for us to ask them. Too often, such questions are ignored altogether, not only in analytical writing but also in courses on analysis. It can be pedagogically inefficient and sometimes unpleasant to bring up such issues, but they frame the very task of performing a pcset-based (or simply atonal) analysis quite well.

Chapters 2–6, respectively, delve into objects and entities, operations, equivalence, similarity, and inclusion. In Chapter 2 ('Objects and Entities'), Schuijer traces the interesting history of using numbers to denote pitches or pitch classes, dating the practice back to the seventeenth century, and he offers an extensive discussion of numbers as used by Babbitt and Forte before going through definitions of pitch class (pc), interval class, and interval-class vectors. It is fascinating reading, but I wondered why Schuijer is quite so fussy when it comes to certain definitions. That might seem like a strange criticism both because this is a journal that is devoted to mathematics and music and because this book traces the history of a subfield that relies so heavily on formalisms. However, Schuijer seems to be working simultaneously as a theorist and historian. It is not always easy to don both hats, especially when he stops chronicling and starts working with his own definitions of familiar concepts.

Schuijer also coins several of his own terms, claiming that Forte's [3,4] definitions are problematic. What most North Americans (at least) call 'interval class' is 'APIC' in this book (for 'absolute pitch-interval class') and directed pc intervals are called PICs (for 'pitch-interval class'). I appreciate Schuijer's reasons, but I wonder whether 'ic' is so unclear that it is worth the change in terminology – especially since if one were to read this book non-linearly, it could be confusing to come across this abbreviation (especially with a glossary being absent). I do not have philosophical objections to Schuijer's definitions, but I also do not think that the now-standard 'interval

class' is so unclear that it is worth lobbying for this change. More to the point, if this really is a historical account, then why attempt to alter the lingua franca? If, on the other hand, this is a textbook for atonal theory, then students who also examine the primary sources in the field might well be confused by Schuijer's idiosyncratic terminology.

Chapter 3 ('Operations') opens with an extended description and definition of transposition. Beyond clarifying that 'transposition' means the musical (not mathematical) sort of transposition, Schuijer spends 10 pages showing examples and historically tracing the use of the word 'transposition' (citing Koch) and talking about the difference between real and tonal answers in fugal practice (citing Rameau, in what seems to me to be a slightly peculiar tangent). I appreciate his care to ensure that readers understand the difference between transposition of pcsets (ordered or unordered) and transposition of pitches (maintaining spacing and/or contour), but his historical account that reaches back to the eighteenth and nineteenth centuries seems rather remote from modern usage.

When Schuijer does move into the mid-twentieth century and begins his discussion of Perle and Forte, he rather quickly shifts his gaze away from abstraction to the difficult matter of Forte's analytical practice, especially his musical segmentations. Schuijer criticizes a number of choices that Forte makes in his analyses of the fifth of Webern's Five Movements for String Quartet, Op. 5 in both *The Structure of Atonal Music* and *The Atonal Music of Anton Webern* [4,5]. Schuijer's criticisms are on the mark, but he could go much farther, not only in critiquing Forte's circled sets (e.g. why doesn't Forte consider the entire initial cello motive to be a seven-note motive? That segmentation could also bear considerable fruit in a pcset-based analysis), but also in examining the very ontology of pcset analysis.

The broader segmentation issues that Schuijer raises are not limited to this chapter, but return, especially in Chapter 6, on inclusion relations. For Schuijer, musical segmentation is linked to the philosophical problems of verifiability and analytical veracity. Concerning the first issue, he writes: 'In Forte's book, musical examples are usually very contracted, so as to enable maximal focusing on the properties discussed. As a consequence, they veil a serious problem: when is a transpositional relationship important?' (p. 59) On the second issue, he writes that 'Forte's selection of PC sets is, of course, open to dispute. However, there is a much bigger problem than its being right or wrong. The above discussion has shown how hard it is to prove the importance of a selection of PC sets – or to disprove it, for that matter. Unordered PC sets are quite malleable: there are no criteria for their verification, how they are projected musically, and how they connect to form larger structures' (p. 60).

I agree that in this case, Forte's musical segmentation seems counterintuitive, so the first criticism seems very reasonable to me – but could not Schuijer's comment be extended to the entire enterprise of pcset-based analysis? Forte is certainly not alone in having produced brief analytical examples and in choosing to label collections of notes that might not seem to form obvious harmonies or motives. The larger, and probably unanswerable, question is how commonly the sort of analysis shown here appears in published or presented papers and books.[1]

I also agree with Schuijer's second broad claim: that atonal analysis lacks verifiability. However, this seems problematic only if one maintains that analysis is in some way scientific, and this is an issue that might stir debate among readers of this journal. If analysis claims to be mathematical, scientific, or both, then it should logically be subject to some clear test of verifiability. If, on the other hand, one maintains that there is no absolute way to judge whether any musical analysis represents some manner of truth or correctness, then we might be left wondering how exactly *analysis* can be mathematical. (It *is* abundantly clear that composers have profitably used mathematical techniques in building their pre-compositional structures. The question really only relates to how we derive post-compositional meaning that moves beyond simply locating and identifying those mathematical – or simply numerical – pre-compositional structures.)

These large issues arise in Chapter 3 during what begins as a rather mundane discussion of transposition. Were one merely skimming the prose, one might reasonably wonder why transposition warrants 10 pages of prose before arriving at the section on inversion. The section on inversion wanders similarly far afield of the particulars of pcset theory. Schuijer relates the atonal sort of inversion (as opposed to the inversion of harmonies) to fugal practice, citing historical treatises by Vicentino, Zarlino, Bononcini, Fux, and Marpurg before getting to Babbitt, the introduction of the index number, and how it is that we can conceive of inversion applied to even a single pitch. Coming on the heels of Schuijer's thought-provoking critique of Forte's Webern analyses, this retreat to the shores of historiography seems surprising.

In his discussion of various ways of calculating inversion, Schuijer makes a compelling, but certainly not unique, argument that inversion is most salient when the axis (comprising either one or two pitches) is readily perceived. He provides examples of how inversions might be described to reflect what is heard in Webern's well-known Variations for Piano, Op. 27 and in the inversion as heard in Berio's *O King* (1967; it later became the second movement of Berio's 1968 *Sinfonia*). He also shows less salient inversionally related pcsets, where there is little chance that inversion would be perceived.

The chapter on equivalence begins with a mathematical definition of what is meant by 'equivalence', and how that can be applied to pitch and pcset theory. It is a rather dry way to begin the chapter and the problem here is that the language is potentially off-putting to readers coming to this book from a musical, not a mathematical, background. I would prefer to see a plain description of what musical equivalence means and then comparisons drawn to the world of mathematics. This book often prioritizes the language of mathematics as a mode of description. That might be appealing to readers of this journal, but Schuijer's prose is noticeably less stimulating during those portions of the book, and broader audiences could be left wondering whether mathematics is conducive to providing compelling music-analytical narratives.

After his lengthy, even painstaking, introduction to the varying definitions of equivalence in the mathematical world, Schuijer addresses my misgivings head-on in an unexpected change of direction:

> [I]t is perhaps unfair to judge definitions of musical relations by purely mathematical standards. However, if this is unfair, then why have these standards been invoked by PC set theorists? Mathematics served them as a model of clarity, as a badge of academic respectability, or as an authority encompassing music as well as many other fields of human knowledge and activity. This is why, in a study of the evolution of PC set theory, we have to deal with these mathematical definitions. (pp. 86–87)

This is a well-reasoned argument for devoting such a substantial portion of the book to proper mathematical definitions, correcting various misuses by musicians. I agree with Schuijer that mathematics has probably been invoked for many – perhaps all – of the reasons he cites. However, I wonder whether, as we look to the future of our discipline, we might more profitably argue that some music theorists have invoked mathematics as a sort of analogy. Ontologically, we might understand such formalistic analytical statements to suggest something more like 'we can think of this musical situation in the same way as we think of mathematical equivalence' rather than 'mathematical equivalence is identical to musical equivalence; the latter must therefore conform to the standards of the former'. This softer philosophical stance might well carry an underlying suggestion that mathematics has only a limited role to play in the service of music analysis, but it should not affect the degree to which we rely upon mathematics in theorizing about musical possibilities.

At the end of the chapter on equivalence, Schuijer tantalizingly suggests that a new and different way of understanding pcset identity can be found in similarity measures:

> One possible locus of identity, the total interval content, was abandoned as a criterion for the classification of PC sets. What united such sets was to be found *between* rather than *in* them. However, there remained an interest in

relations between PC sets on the basis of their intrinsic properties. 'Similarity' was a concept by which one hoped to approximate these relations. (p. 129, Schuijer's emphasis)

Any such hope is dashed relatively quickly in Chapter 5 (on similarity measures). A few pages in, Schuijer comments that

… when we identify PC sets and trace transpositional, inversional, complementary, and inclusional relations between them, we are in the analytical tradition that has developed at professional schools of music, and that has had a formative influence on composers, performers, scholars, teachers, and editors alike. … This is not the case with similarity relations. PC set similarity was originally a concept without a clearly defined function, and without a history that would render it authoritative. This situation has never really changed. (p. 133)

Schuijer grounds pcset similarity in the chord classification schemes of Hindemith [6] and Krenek [7], but he spends most of the chapter summarizing a few of the formative similarity measures, from Teitelbaum [8] to Morris [9], Rahn [10], and Lewin [11]. He does a fine job of explaining differences in both the types of data that they weigh and the ways in which each measure processes its data. His assessments of the measures' strengths and weaknesses are also helpful and well considered. But, at the risk of sounding a bit self-serving, I thought it was a shame that the price of his lengthy exposition of the formative relations was an almost complete neglect of similarity relations created during the last two decades.

In fairness, most of these newer relations have also seen little, if any, analytical use (beyond their use by the measures' creators), but they do represent some very different ways of doing business. In particular, Hermann's [12] work is notable for its parametric flexibility (Hermann does not limit himself to pitch and pitch class), and my own various measures [13,14] and Castrén's [15] RECREL generally use familiar means of comparing data, but the data themselves are pre-processed to account for differences in cardinality (and I would modestly suggest that, at least with my saturation-based measures, this accounts for a true difference in how the data are farmed). Moreover, while I think that Ian Quinn's excellent article 'Listening to similarity relations' [16] perhaps focuses a bit too broadly on the forest, not appreciating the beauty of individual trees, it seems to me that Schuijer takes stock of only a few of the trees that inhabit that metaphorical forest and Quinn's conclusions are well worth a mention. Quinn's more recent work on Fourier scales and qualitative genera [17] also rightly belongs in this chapter; his geometrical distance measurements amount to similarity relations in spirit, if not in philosophy.[2]

Chapter 6, on inclusion, provides very clear explanations of various inclusion relations, including the notions of supersets, subsets, and how they form families of related set types. Moreover, as in earlier chapters, Schuijer traces a prehistory of such pcset-based inclusion to earlier tonal theory (especially to Gottfried Weber's theory of key relationships). He also provides a really excellent summary of Forte's K and Kh relations and their role in divining a nexus set and I was fascinated, if not entirely convinced, by his comparison of K and Kh to nineteenth-century dualist accounts of tonal theory. As different as I think they are, set-complex theory may indeed share some philosophical common ground with the dualists.

Beyond the clear descriptions of how pcset theory incorporates the notion of inclusion into its analytical toolbox, this chapter also revisits the problem of separating the relatively abstract notions of pcset relatedness from the concrete issue of musical segmentation. This was touched upon earlier in the book when Schuijer cited Lerdahl's claim that the method 'provides no criteria for segmenting the musical surface into sets' [1, p. 66]. To which Schuijer added: 'Indeed, without such criteria there is no way of knowing with certainty which tones form a meaningful combination' (p. 23). After that statement, it seems a bit disappointing the Schuijer offers only two criteria (pp. 187–88). But were there many more criteria, I would still wonder how we can ever feel certain about segmentation (especially in complex polyphonic music), which is as thorny an issue we face when performing analysis.

The final two chapters form a critical history that traces the growth and development of pcset theory in the USA. The penultimate chapter, '"Blurring the Boundaries": Analysis, Performance,

and History' provides not only a historical account of the place of analysis in American music theory but also a rather sympathetic reading of the various critical blows it has received. The final chapter, 'Mise-en-Scène', hypothesizes how and why pcset theory became an integral part of American university curricula. Both chapters are absorbing and I admire Schuijer's well-researched tale of how and why something as abstract as pcset theory became the normative methodology for teaching twentieth-century music analysis in our undergraduate music theory classes. However, I simultaneously found myself adamantly disagreeing with Schuijer's (and Taruskin's) equation of the aesthetic and musical ideals innate to pcset theory and Schenkerian analysis.

Does Schenkerian analysis, like PC set theory, amount to nothing more than a set of tools, as Schuijer argues (p. 222)? It seems to me that the tools which are often the hallmarks of a Schenkerian analysis – those odd-looking beamed half notes, unstemmed note heads, spider-like unfolding beams, and abundant slurs – merely *represent* an analysis and that they do not *constitute* an analysis. Moreover, they are not applied without substantial interpretive guidelines. Another substantial difference is that the structures and tools of Schenkerian analysis are conveyed using music notation (rather than more abstract symbols) which more readily enables us to hear or see a particular musical interpretation. This is quite different from the situation with pcset (and also transformational) modes of analysis where the tools of the trade are not firmly linked with an underlying method for application, especially since set-complex analysis has fallen out of favour.[3]

I find Schuijer's arguments far more compelling when he talks about the performative aspects of analysis and creates a wonderful ideal of what atonal (or any) analysis should aspire to attain. 'The question is: how does an analysis convince us as a performance, quite apart from the empirical or historical evidence that it may produce?' (p. 223) He advocates that 'an analysis should also be convincing as an *act*. That is, one should be made to believe that the musical work reveals itself *through the analysis*. There is a growing literature on this aspect of the discipline, an objective that is as vital as it is difficult to achieve' (p. 223, Schuijer's emphasis). Chapter 7 concludes with a fascinating meditation on the goals of analysis and how analysis can be propped up by identifying a canon of works for which its claims seem valid.

The final chapter opens with a convincing and well-argued hypothesis that the growth of pcset theory is largely attributable to the rise of the computer in the 1960s, especially at Princeton, and to the heightened academic status that was associated with using computers. Schuijer also convincingly draws a line connecting the goal of attaining academic credibility to pcset theory's current pedagogical entrenchment (at least in North America) by focusing on Forte's contribution to a seminar on comprehensive musicianship that was held at Northwestern University in 1965. According to Schuijer, Forte advocated teaching these most 'sophisticated' (including computer-aided) techniques for music analysis in written and aural skill classes, suggesting either an active attempt to make his ideas relevant and palatable to undergraduates (and, more immediately, to people who teach undergraduates) or a rather calculated attempt to advance his own career by infusing the undergraduate curriculum with his own concepts of abstract structure and design.

Schuijer also claims that pcset theory was viewed as compatible with the push for educational democratization in the USA.

PC set theory is not only the product of the scientification of music theory, but also of a commitment to education. Whoever rejects its formalism and reductionism, and finds its language inappropriate, should bear in mind that these aspects serve the purpose of equal opportunity. They enable anybody who is interested, and perseveres, to develop an expertise in some of the art music of the post-1900 era and to hand it down to others. It may be hard to believe that the mathematical borrowings and the more arcane relational concepts are interesting to those outside a highbrow elite; but whoever thinks they are, therefore, incompatible with an idealistic notion of mass education, should be reminded that this notion does not exclude the emergence of such elites. Rather, it allows various levels of prior ability and acknowledges various levels of achievement. (p. 277)

Schuijer hypothesizes that pcset-based analysis might not have seemed appealing in Europe because Europeans are more comfortable with aristocratic notions of education (or at least music education).

This provocative theory about the progress of pcset theory in the USA comes at the end of Schuijer's book. As an American, I found myself wondering whether it truly is our national belief that we should have well-defined tasks and that we should be able to apply objective standards for evaluation and quantification. Moreover, are these bureaucratic educational goals what led to pcset theory's success in the USA and to its embedding within most of our college curricula? Schuijer certainly is right that a majority of our current undergraduate textbooks that include sections on post-tonal music analysis promote pcset theory as a – or sometimes *the* – method of choice.

I do not have answers to the above questions, but the fact that I found myself questioning the origins of my own principles and goals says a lot about the strength of Schuijer's arguments and how close to home they hit me. While reading this book, I also learned more about the history (and pre-history) of pcset theory than I had anticipated and I agreed with the vast majority of Schuijer's aesthetic claims and methodological critiques. Where I disagreed, I often found myself sharply arguing with the book, but, as I said at the outset, arguing with Schuijer was tremendously helpful in considering and reconsidering my own views of the field. Despite its rather banal title, *Analyzing Atonal Music: Pitch-Class Set Theory and Its Contexts* is provocative, engaging, informative, and occasionally maddening. I will continue to re-read it and will surely assign at least portions of this important book to my graduate students in future atonal analysis classes that I teach. I can only hope that it incites many productive arguments and helps us ask more and better critical questions about atonal music theory and analysis.

Notes

1. I personally think that unconvincing segmentation is a serious issue facing everyone who works with post-tonal music, but it is too large an issue to address in this forum (and even in Schuijer's book, it deserves greater space). In a recent talk [18], I likewise discussed the difficulty in appreciating one's analytical methodology when faced with poor analytical segmentation.
2. Schuijer's book carries a 2008 imprint date, but it is of course possible that his manuscript was published before Quinn's [17] two-part article; it is also possible that Quinn's 2004 dissertation, on which the *PNM* articles are closely based, was not yet widely available.
3. I have argued elsewhere that the sense of hierarchy in Schenkerian analysis is profoundly different from that applied in atonal, and especially, transformational analysis [19, par. 59–68].

References

[1] F. Lerdahl, *Atonal prolongational structure*, Contemp. Music Rev. 4 (1989), pp. 65–87.
[2] F. Lerdahl and R. Jackendoff, *A Generative Theory of Tonal Music*, MIT Press, Cambridge, MA, 1989.
[3] A. Forte, *A theory of set-complexes for music*, J. Music Theory 8(2) (1964), pp. 136–183.
[4] A. Forte, *The Structure of Atonal Music*, Yale University Press, New Haven, CT, 1973.
[5] A. Forte, *The Atonal Music of Anton Webern*, Yale University Press, New Haven, CT, 1998.
[6] P. Hindemith, *Unterweisung im Tonsatz: Theoretischer Teil*, Schott, Mainz, 1937.
[7] E. Krenek, *Studies in Counterpoint*, Schirmer, New York, 1940.
[8] R. Teitelbaum, *Intervallic relations in atonal music*, J. Music Theory 9 (1965), pp. 72–127.
[9] R.D. Morris, *A similarity index for pitch-class sets*, Perspect. New Music 18(1–2) (1979–1980), pp. 445–460.
[10] J. Rahn, *Relating sets*, Perspect. New Music 18(1–2) (1979–1980), pp. 483–498.
[11] D. Lewin, *A response to a response: on pcset relatedness*, Perspect. New Music 18(1–2) (1979–1980), pp. 498–502.
[12] R. Hermann, *A general measurement for similarity relations: a heuristic for constructing or evaluating aspects of possible musical grammars*, Ph.D. diss., University of Rochester, 1993.
[13] M. Buchler, *Broken and unbroken interval cycles and their use in determining pitch-class set resemblance*, Perspect. New Music 38(2) (2000), pp. 52–87.

[14] M. Buchler, *Relative saturation of intervals and set classes: A new approach to complementation and pcset similarity resemblance*, J. Music Theory 45 (2001), pp. 263–343.

[15] M. Castrén, *RECREL: A Similarity Measure for Set-Classes*, Studia Musica 4, Sibelius Academy, Helsinki, 1994.

[16] I. Quinn, *Listening to similarity relations*, Perspect. New Music 39(2) (2001), pp. 108–158.

[17] I. Quinn, *General equal-tempered harmony*, Perspect. New Music 44(2) (2006), pp. 114–159, and 45(1) (2007), pp. 4–63.

[18] M. Buchler, *Are there any bad (or good) transformational analyses?* Society for Music Theory Annual Conference, Indianapolis, IN, 2010.

[19] M. Buchler, *Reconsidering Klumpenhouwer networks*, Music Theory Online 13(2) (2007). Available at http://mto.societymusictheory.org/issues/mto.07.13.2/mto.07.13.2.buchler.html

Michael Buchler
Florida State University, USA
mbuchler@fsu.edu